A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

NOVEMBER, 1935.

GENERAL PHYSICS.

ADSORPTION.

4423. Generalised Sorption and New Electrocapillarity Equations. B. Derjaguin. *Acta Physicochimica*, 2. 3. *pp.* 377–384, 1935. *In German.*—By considering the change in free energy occurring when a known volume of gas in isothermal equilibrium in a gravitational field is brought into contact with a sorbent, general volume-sorption equations (applicable, *e.g.*, to porous absorbents) are derived. The only assumption made is the reversibility of the sorption process, this expression being used in its widest sense, so as to include such processes as capillary condensation in pores, occlusion, absorption, etc. By replacement of gas pressure and density by osmotic pressure and concentration, the equations become applicable to sorption from a solution or mixture. From these equations, a whole series of special relationships, particularly Gibbs' equation for adsorption at phase boundaries, may be derived. By introduction of an electrostatic field in place of the gravitational field, a new electrocapillarity equation is also derivable. T. H. P.

4424. Van der Waals Activated and Atomic Adsorption of Hydrogen by Copper and Nickel, and their Influence on the Photoelectric Effect. O. I. Leypunsky. *Acta Physicochimica*, 2. 6. *pp.* 737–760, 1935. *In German.*—It is shown that activated adsorption is characterised by the presence of an appreciable steric factor and that adsorption is connected with diffusion processes. Cu obtained by vacuum distillation is not capable of activated adsorption, which points to a special structure being necessary for the latter phenomenon; similarly Cu which has been consecutively oxidised and reduced is incapable of activated adsorption. The hypothesis is advanced that in the usual methods for the preparation of catalysts, the presence of impurities which prevent metallic crystallisation before sintering, are active as structural factors. It is shown that in the case of Ni the surface is very inhomogeneous with respect to its adsorption properties and only about 10 % of it is activated. Neither the H adsorption at high nor at low temperatures influences the photo-effect of Ni. The adsorption at − 183° C. of atomic H by both Cu and Ni takes place to a covering thickness of about 300 % of the mono-layer. Atomic H promotes the photo-emission of Cu and Ni. The opinion is expressed that the activated adsorbed H on Ni is not atomic. The kinetics of desorption of atomic H on Ni at − 106° C. have been worked out and the data found to satisfy the formula $q = at/(1+bt)$; the latter formula was derived on the assumption of recombination in consequence of collision at the surface with subsequent desorption of the molecules. The heat of activation was found to be 23,800 cal. H. H. Ho.

4425. Adsorption on Wood Charcoals in Solutions and Gases. H. Fischer. *Kolloid-Beihefte*, 42. 4–9. *pp.* 125–183, *Aug.* 1, 1935.—It is shown that adsorption for all types of charcoal takes place more or less slowly; the rate of adsorption can best be studied by adsorption from solutions; in solutions the rate of adsorption is relatively small; that for all types of charcoal the rate of adsorption, and for coated charcoals also the adsorption equilibrium, are dependent on the size of the charcoal particles; the greater the charcoal particles the smaller the rate of adsorption and also for coated charcoals the amounts adsorbed in equilibrium. Reference is made to the suspension phenomenon of succinic acid adsorption. It is found that with reference to after equilibrium or to the amount taken up after a definite time of adsorption the different charcoals can be arranged in the same serial order with respect to succinic acid, iodine from potassium iodide solutions, iodine from alcohol, and methylene blue from aqueous solutions. The adsorption for open charcoals is clearly greater than for dense and coated charcoals. For vapours (SO_2) the serial arrangement of the different charcoals is the same, whether for amount adsorbed or for rate of adsorption, as for solutions. For gases (C_2H_4 and CO_2) the dense charcoals adsorb better than open charcoals, particularly for CO_2. The rate of adsorption for gases is greater than for solutions. This is put down to the easier molecular movement of gases. In general, adsorption increases with molecular weight; this is the case for open charcoals. J. K.

4426. Adsorptive Power of Wood Charcoal. H. Herbst. *Kolloid-Beihefte*, 42. 4–9. *pp.* 184–301, *Aug.* 1, 1935.—It is observed that charcoals with lower powers of adsorption are far less readily wetted by water than those of good adsorptive power. The bad wetting is put down to the presence of tar impurities because improvement results when the charcoals are purified. It is suggested that the known process for producing charcoal products of good adsorptive power by means of $ZnCl_2$ is probably due to the fact that only small quantities of tar products are produced. It is also suggested that probably the pure " active " charcoal (C_6) is the carrier of the adsorptive power. It is shown that the power of adsorption of organic materials such as wadding and wood is small for gases, this being in agreement with the work of Michaelis and Rona on adsorption from solutions. It is stated that the technically best adsorptive charcoals have as a general rule the maximum content of pure carbon. It is pointed out that to determine the technical importance of an adsorbing charcoal, knowledge of static adsorptive power is insufficient, as porosity is also important and that coarse porosity has to be distinguished from ultra-porosity. Ordinary porosity can be measured by determining the ordinary and apparent specific gravities with water and mercury as pyknometer fluids. It is shown that the rate of adsorption increases with the porosity and is thus inversely proportioned to the apparent specific gravity. For practical purposes, as gas filters, the apparent specific gravity should not be higher than 0·7. It is also shown that by heating above 1100° a detrimental graphitisation of the charcoal is observed with respect to the power of adsorption. J. K.

See also Abstracts 4440, 4443, 4491.

ATOMIC AND MOLECULAR STRUCTURE.

4427. Theory of Nuclear Masses. C. F. v. Weizsäcker. *Zeits. f. Physik*, 96. 7–8. *pp.* 431–458, *Sept.* 7, 1935.—The general behaviour of mass defects is considered. The rise of the packing portion towards the side of the light nucleus can be shown on the hypothesis of a superficial tension of the " nuclear fluid." The weightiest contribution to this superficial tension is afforded by the blurring of the nuclear border exacted by the disagreement relation. This effect may be considered in the Thomas-Fermi method if the eigenfunctions in each small partial volume of the nucleus are set out not as plane waves but as waves with linear varying amplitude. If the interchange potential between neutron and proton is expressed in the form $J(r) = ae^{-br}$ (where r is the nuclear radius) for the correct exhibition of the mass defect of O there must be a relation between the constants a and b. The hypothesis that protons and neutrons under the influence of the interchange force are connected from time to time in double shells leads to the rule that the combination energy of a nucleus which contains an uneven number of neutrons is somewhat smaller than the arithmetical mean of the combination energies of the two nuclei which contain as many protons and a neutron less or more. Similarly for the corresponding rule for uneven proton numbers. The mass defects of the nucleus of even charge and mass may be expressed as the sum of three simple functions of the number of particles which signify the volume energy of the nuclear fluid, the superficial tension, and the Coulomb repulsion energy (corrected by an interchange term) of the protons. Therefore the fluid energy should be proportional, not to the atomic weight $(Z + N)$, but to $(Z + N - 1)$, Z being the number of protons and N the number of neutrons in the nucleus. [See following Abstract.] J. J. S.

4428. Structure of the Light Atomic Nucleus. S. Flügge. *Zeits. f. Physik*, 96. 7–8. *pp*. 459–472, *Sept*. 7, 1935.—The extension of Majorana's model made by v. Weizsäcker [see preceding Abstract] is developed in the case of the light nucleus in which the surface layer is comparable with the nuclear radius. A bell-shaped curve is given which shows the thickness distribution. The calculated values for the constants of the law of force show, as always with the Thomas-Fermi method, no agreement with Wigner's values. A calculation of the nuclear radius is given, from which it appears that the $\sqrt[3]{Z}$ law (where Z is the atomic number) for the light nucleus no longer holds but is completed by an additional term which depends on the superficial tension. The influence of the Coulomb forces is discussed with consideration of the interchange forces between the protons produced by them. Another law of force between neutron and proton is given. J. J. S.

4429. Structure of the Light Atomic Nuclei. W. Heisenberg. *Zeits. f. Physik*, 96. 7–8. *pp*. 473–484, *Sept*. 7, 1935.—The mass defects of the light atomic nuclei are calculated according to a simplified Hartree's process from the law of force $J(r) = a\, e^{-b^2r^2}$. The constants a and b so determined from the mass defects agree actually better with the values determined by Wigner and Feenberg than with the values obtained by Majorana's method. The errors of the methods are discussed. J. J. S.

4430. Nuclear Evolution of Iron, Cobalt and Nickel. H. J. Walke. *Phil. Mag*. 20. *pp*. 738–739, *Oct*., 1935.—In view of Aston's results [see Abstract 1904 (1935)] that $^{57}_{26}Fe$ is stable and $^{58}_{26}Fe$ missing, in place of the author's previous suggestions [see Abstract 1307 (1935)] regarding the origin of Ni and Co, it is suggested that $^{58}_{28}Ni$ and $^{60}_{28}Ni$ have resulted by β-ray emission from the missing $^{58}_{26}Fe$ and $^{60}_{27}Co$ respectively; and also that $^{58}_{26}Fe$ was of sufficiently long life for the formation of $^{59}_{26}Fe$ by neutron capture, whence $^{59}_{27}Co$ would be formed by β-ray emission. C. A. S.

4431. Artificial Nuclear Transformations. R. Fleischmann and W. Bothe. *Ergeb. d. exakt. Naturwiss*. 14. *pp*. 1–41, 1935.—Summary of work on artificial nuclear transformations with particular reference to:—(1) production of nuclear transformations by corpuscular and γ-rays; (2) emission of deutons; (3) resonance disintegration; (4) disintegration without capture; (5) disintegration by heavy nuclei and by penetrating radiation; (6) branching transformations; (7) disintegration of the same nucleus in different ways; (8) step-wise transformation; (9) formation of isotopes of high order; (10) radioactive substances artificially produced by α-particle, deuton, proton and neutron bombardment; (11) emission of neutrons by artificially produced radioactive substances; (12) energy distribution of electrons and positrons emitted by artificially produced radioactive substances; (13) separation of radioactive isotopes; (14) dependence of yield on neutron energy and presence of paraffin wax; (15) addition and exchange of slow neutrons; (16) velocity and absorption of slow neutrons; (17) theory of the interaction of neutrons and nuclei; (18) production of γ-rays by α-particle, proton, deuton and neutron bombardment; (19) new nuclei of interest H^3, He^3, Be^8, elements 93 and 94 and the radioactive series $4n + 1$; (20) discussion of nature of neutron, positron, neutrino and negative proton; (21) summary of known nuclear reactions; (22) properties of nuclei of artificially produced radioactive substances; (23) exact masses of light atoms. A Bibliography of 272 papers published in 1934 and 1935 is appended. F. C. C.

4432. Disintegration of Be with Protons. B. Zipprich. *Zeits. f. Physik*, 96. 5–6. *pp.* 337–341, *Aug.* 31, 1935.—Using an electrometer and a double ionisation chamber the author has examined the disintegration products of Be when subjected to bombardment with 50 kV protons. A group of particles having a range of about 6·6 mm. is identified and from the size of the electrometer deflections the particles are shown to be α-particles. The yield is about the same as that from Li. J. E. R. C.

4433. Artificial Radioactivity (Curie-Joliot Process). Part II. H. Fahlenbrach. *Zeits. f. Physik*, 96. 7–8. *pp.* 503–511, *Sept.* 7, 1935.—Continuing previous work [see Abstract 2330 (1935)] the artificial radioactivity produced by the bombardment of Si and Mg with α-rays is examined with an all Al tube counter 4 cm. long, 2 cm. dia. and 100μ thick. Powdered Si irradiated continuously for 18 d. by α-rays from ThB + C gave an induced radioactivity of half-value period 14 d. attributed to P^{32} and already reported by Fermi when Cl and S are bombarded with neutrons. With Mg, besides the activity of half-value period $2·1 \pm 0·2$ min. due to the formation of Al^{28}, a further activity of half-value period 6·7 min. attributed to Si^{27} and formed from Mg^{24} is reported. The excitation curve for the Curie-Joliot process for Mg shows two resonance levels at 5·4 and 6·1, ekV, both attributed to Mg^{25} and agreeing with the resonance levels for proton emission found by Duncanson and Miller. The absolute values for the disintegration probability for Mg are in good agreement with those of other workers. F. C. C.

***4434. Yield of Positrons and Electrons from the Transformation of γ-Radiation in Metals. T. Benecke.** *Zeits. f. Physik*, 96. 9–10. *pp.* 571–587, *Sept.* 12, 1935.—A new expansion chamber is described, the chief feature of which is that the piston which produces the expansion in the chamber is driven by a second piston moving in a cylinder below the expansion chamber. The apparatus is used to investigate the yield of positrons and electrons from Al, Ni, Au, and Pb irradiated with the hard component of Th″ γ-radiation. Measurements of the absorption coefficients of the particles are made and are used to reduce the ratios of the observed yield to "thin sheet values." Calculation of the yield ratios are made based upon the Klein-Nishina formula for scattering and the formula of Bethe and Heitler for the production of electron pairs, and found to agree reasonably well with the observed values. The positron yields from Pb and Al are compared and the ratio shown to agree with Bethe and Heitler's prediction that the yield should vary as the square of the atomic number. J. E. R. C.

4435. Isotopic Systems. K. Sitte. *Zeits. f. Physik*, 96. 7–8. *pp*. 512–519, *Sept*. 7, 1935.—If a diagram is plotted with nuclear charge Z as abscissa and $(m\text{-}Z)/Z$ as ordinate where m = nuclear mass for the experimentally known isotopes, by simple considerations of the total binding energies a series of hitherto undiscovered isotopes may be predicted. The results agree essentially with those already obtained by Mattauch [see Abstract 4784 (1934)], but a few further possible isotopes are indicated while the existence of others is shown to be very improbable. F. C. C.

4436. Isotopes. F. W. Aston. *Science*, 82. *pp*. 235–240, *Sept*. 13, 1935.—A report of an address giving an outline of the theory and experiments leading to the discovery and explanation of the isotopes and heavy hydrogen. N. M. B.

4437. Neutrons. G. E. Monod-Herzen. *Ann. de Physique*, 4. *pp*. 137–201, *Sept*., 1935.—Previous work is summarised and discussed with a Bibliography (to 1934) of 208 items. With Po + Be or Rn + Be (about 10 m. curie) and the Wilson chamber 7500 pairs of photographs of trajectories were examined. Apart from " spontaneous " trajectories (*i.e.*, those also observed in absence of any source of neutrons and possibly indicating that cosmic rays consist partly of neutrons) the results point to neutron-proton collisions resembling those of two frictionless elastic spheres, and to the source emitting slow and fast neutrons, the slow being strongly (80 %), the fast scarcely, diffused by matter. The mass of the neutron is then deduced from energy considerations as $1{\cdot}009 \pm 0{\cdot}001$, and the losses of mass according to J. Perrin's nuclear theory [see Abstract 4859 (1933)] calculated for 34 elements (59 isotopes). Lastly a detailed account of the " isotopic capacity " curve (obtained by plotting the total number of isotopes of elements of atomic numbers Z, Z + 1, Z + 2, and Z + 3 against Z) is given. [See Abstract 25 (1935).] C. A. S.

4438. New Formulation of the Pauli Principle for Valency Problems. A. A. Schuchowitzky. *Acta Physicochimica*, 2. 1. *pp*. 81–90, 1935. *In German*.—The complex nature of the application of the Pauli principle has led to the need of more simplified treatment, and essential progress in this direction has been recently accomplished by Hellmann (*Acta Physicochimica*, 1, 913, 1935), whose method, however, which is based partly on statistical hypotheses, is inapplicable to the case of electronic deficiency without reservations. The present author now submits an approximation method based on wave-mechanical conceptions and without recourse to statistical considerations, which can be combined with Hellmann's process for complex molecules. The paper is entirely mathematical, and leads essentially to the same results as the Heitler-London method. H. H. Ho.

4439. Constitution of Water in Solutions of Non-Electrolytes. Part I. Acetone. C. S. S. Rao. *Phil. Mag.* 20. *pp*. 587–594, *Oct*., 1935.—The main results obtained may be briefly summed up as follows: The Raman band for water gets sharper with increasing concentration of the dissolved substance. The intensity maximum of the band, which is in about the same position as for water, does not shift with change of concentration as is the case with strong and weak electrolytes [see Abstract 3730 (1935)]. While the larger frequency portion of the intensity curve of the water-band does not suffer any appreciable change, the smaller frequency branch shifts to the greater frequency side and changes from convex to concave in its shape as the concentration of acetone is increased. These results are discussed in relation to change in water equilibrium and in " physical hydration," and are shown to indicate the preponderance of double water molecules and double hydrates over the other types, especially at higher concentrations of the dissolved substance. AUTHOR.

See also Abstracts 4482, 4580, 4583, 4597, 4598, 4607, 4624, 4680, 4681, 4682, 4683, 4696.

COLLOIDS.

4440. Stability of Silver Iodide Sols. G. N. Gorochowsky and J. R. Protass. *Zeits. f. phys. Chem.* 174. *Abt.A.* 2. *pp.* 122–134, 1935.—From measurements of the intensity of the light scattered by AgI sols with concentration of the disperse phase 5×10^{-3} to 5×10^{-5} *M*, conclusions regarding the stability of the sols are drawn. The dependence of the stability on the concentration of one of the two ions in excess has been determined, as well as the influence of electrolytes with kations of different valency. Th^4 ions are able to impart a positive charge to the AgI. The stability of the AgI sol is influenced similarly by excess of its own ions and by foreign ions. It is concluded that the stability of sols depends principally on adsorption phenomena. T. H. P.

4441. H.V. Electroendosmosis of Non-Aqueous Liquids. H. P. Dakin, F. Fairbrother and A. E. Stubbs. *Chem. Soc., J. pp.* 1229–1233, *Sept.*, 1935.—Measurements have been made of the electroendosmosis of a number of organic alcohols and ethers through a diaphragm of sintered Jena Geräte glass powder, applied voltages up to nearly 6000 V per cm. being used. At low voltages, the relation between the voltage applied to the diaphragm and the velocity of flow of the liquid is linear, or nearly so, but departs to an increasing degree at high voltages. A continuous photographic method of recording the rate of electroendosmosis is described, which permits observations to be made of high speeds over a short time and of any change of speed during a run. The electroendosmotic flow attains a constant speed within a very small fraction of a second after the application of the e.m.f. AUTHORS.

4442. Microscopic Observation of Electrophoresis. H. H. Waelsch. *Kolloid Zeits.* 73. *pp.* 36–39, *Oct.*, 1935.—In this method for determining the sense and magnitude of the charge on dye particles, etc., the migration of the particles is observed, under the highest magnification possible, in a hanging drop attached to a strip of moist cellophane paper. By a modification of the procedure macroscopic demonstration of the migration of dyes in an electric field becomes possible. The final result or the various phases may be preserved as permanent coloured specimens. T. H. P.

4443. Adsorption Theory of Electrokinetic Potential. A. March. *Faraday Soc., Trans.* 31. *pp.* 1468–1478, *Oct.*, 1935.—It has been pointed out that the facts can only be brought in accordance with a theory which considers the ϵ- and ζ-potential as independent quantities. The course of the potential within a double layer due to an unequal adsorption of the ions has been examined. The result is a very simple connection between the value ϕ_0 to which the potential rises in the layer, and the difference of the adsorption potentials. The order of magnitude of ψ is calculated from experiments on the adsorption of Cl-ions by Fe_2O_3 sols. The order found in this way corresponds to that of ζ. The way in which ϕ_0 also reacts upon the addition of an electrolyte is quite that of ζ, which accordingly, in all probability, must be interpreted as an adsorption effect. The mechanism of the exchange adsorption is made clear by means of a figure which shows that the principle of equivalency does not hold for this process.

AUTHOR.

4444. Diffuse Dispersion of Light in White Non-Metallic Sols. G. P. Lutschinsky. *Kolloid Zeits.* 73. *pp.* 39–42, *Oct.*, 1935.—The application of Lambert's law to the passage of white light through colloidal solutions is complicated by the change in the quality of the light throughout the passage and the consequent continuous change in the absorption coefficients. When light penetrates a colloidal solution the scattered light is decomposed more or less sharply, according to the degree of dispersion of the sol, into a spectrum. A modification of Lambert's formula for the complex light and for the calculation of the quantities of the absorbed and diffused lights is derived, and curves for the distribution of the intensity of these two according to the wave-length are given. T. H. P.

4445. Viscosimetric Investigations on the Structure-Formation of V_2O_5–Sols. Part III. G. Schumann. *Acta Physicochimica*, 2. 6. *pp.* 793–808, 1935. *In German.*—The effect of sodium salts with the anions Cl, Br, NO_3, SO_4, and CrO_4 on the structure formation of three V_2O_5 sols is investigated by means of viscosity-pressure curves. The Cl ion has the greatest power of promoting the formation, NO_3, Br, SO_4 and CrO_4 following in order. The differences in action between the different anions are explainable partly by the lyotropic properties; the greater the hydration of the anion, the greater its effect. On the other hand, Pauli's discharge effect also acts, so that the sulphate ion stands after the bromine ion and not at the beginning of the series. During the first days after their addition to the sols all the sodium salts depress the structure viscosity. [For Part II see Abstract 2346 (1935).] T. H. P.

See also Abstract 4478.

CRYSTAL STRUCTURE AND PROPERTIES.

4446. Dynamical Theory of the Diamond Lattice. N. S. N. Nath. *Indian Acad. Sci., Proc.* 2A. *pp.* 143–152, *Aug.*, 1935.—The diamond-graphite transformation is explained in terms of three elementary operations: a displacement of the two cubic face-centred lattices of diamond relative to one another along a particular direction, a homogeneous dilatation of the whole crystal along the same direction, and a homogeneous gliding of the planes obtained by these two transformations perpendicular to the same direction. It is shown that for a certain displacement of the component lattices, diamond attains the maximum energy of its configuration and becomes unstable. The temperature of instability and transformation to graphite is calculated from the Nernst-Lindemann formula for the heat content of a crystal and gives the value 1850° approximately, which is in good agreement with the experimental determinations 1650–1885°. [See Abstract 3257 (1935).] N. M. B.

4447. Crystal Structure and Electron Configuration of Transition and Univalent Metals. U. Dehlinger. *Zeits. f. Physik*, 96. 9–10. *pp.* 620–633, *Sept.* 12, 1935.—Recent work on the electronic structure of metals is considered theoretically and a number of deductions are made. With few exceptions, the following rules hold; the structures of the transition metals lie symmetrically in the periodic table with respect to the vertical column (Cr, Mo, W) in which 6 outer electrons are present; for 2 and 10 outer electrons cubic face-centred lattices are observed, for 3 and 9 hexagonal packing and cubic face-centred lattices occur together, for 4 and 8 and 5 and 7 hexagonal packing and with 6 and 1 a body-centred cubic lattice occurs. The structure of the transition metals may be built up from *d*-electron shells; of the 6 outer electrons, one is an *s*-electron and the remainder *d*-electrons. If the bonds are chiefly governed by orbital valency, close packing is obtained; in the absence of one *d*-electron per atom, a cubic packing is observed but if more than one *d*-electron per atom is absent, hexagonal or cubic packing may occur. A body-centred cubic lattice is obtained if the bonds are governed chiefly by spin valency. The crystal lattice of Fe is considered theoretically, particularly with respect to the changes induced in the lattice by thermal treatment. H. J. H. S.

4448. Allotropy of Pure Calcium. A. Schulze. *Phys. Zeits.* 36. *pp.* 595–598, *Sept.* 15, 1935.—Cooling curves, and the measurement of electrical resistance and thermal expansion lead to the result that two allotropic changes take place in very pure Ca. This is in agreement with X-ray work on the same subject. The α-β change takes place at about 300° C., and the β-γ change takes place at about 450° C. The purity of the Ca used is 99·9 %. J. T.

4449. Explosive Antimony. Part II. Structure, Electrical Conductivity and Rate of Crystallisation. C. C. Coffin. *Roy. Soc., Proc.* 152*A*. *pp.* 47–63, *Oct.* 15, 1935.—Microscopic study of polished and etched surfaces shows that the explosive electrolytic deposit of antimony has a heterogeneous gel-like structure in which one phase is oriented parallel to the lines of the depositing current. This phase, which is soluble in $(NH_4)_2S$ solution, is regarded as an $SbCl_3$-Sb complex resulting from the deposition of a complex ion, the other phase being probably amorphous Sb. For fresh deposits the specific resistance, which is about 10^5 times that of ordinary Sb and has a negative exponential temperature coefficient, is given by $\log \rho = 8 \cdot 7 \times 10^2/T + 0 \cdot 095\,C - 3 \cdot 26$, where C is the percentage of $SbCl_3$ in the metal. Ohm's law is obeyed and Faraday's law is not involved, so that the conduction is probably metallic. Between 55° and 100° C. amorphous Sb crystallises at a measurable rate which is independent of the amount of salt in the metal and is given by the equation of a first-order reaction: $\ln k = 31 \cdot 40 - 27{,}300/RT$. [For Part I see Abstract 4632 (1934).] T. H. P.

4450. Effect of Thermal Agitation on Atomic Arrangement in Alloys. Part III. E. J. Williams. *Roy. Soc., Proc.* 152*A*. *pp.* 231–252, *Oct.* 15, 1935.—The equilibrium equation for a general case, assuming the energy associated with the atomic arrangement to be uniquely determined by the superlattice order, is derived from the Boltzmann distribution formula and also from the principle of minimum free energy. The entropy and energy corresponding to the solution recently given by Bethe, assuming the energy of the atomic arrangement to be determined by the order of nearest neighbours, is also discussed, and a method of estimating the quantitative relation of Bethe's type of treatment to that of Bragg and Williams is given. The paper concludes with a general discussion of existing theory and of the possible modifications for improving the relation to experiment. [For Part II see Abstract 4075 (1935).] AUTHOR.

4451. Oxidation of Metals. Part II. G. D. Preston and L. L. Bircumshaw. *Phil. Mag.* 20. *pp.* 706–720, *Oct.*, 1935.—The authors' work on the examination of oxide films on metals by means of electron-diffraction, is continued [see Abstract 555 (1935)]. The films investigated are those formed on Cu, brass, Al-brass, Al-bronze, Mg, and some Mg alloys. The oxidation takes place at temperatures up to 400° C. The film formed on Cu consists of Cu_2O, no definite indication of CuO being found. The oxide is orientated with the (111) plane parallel to the surface. Brass is also found to be covered with a film of Cu_2O, at temperatures up to 183° C. At 400° C. the film is of ZnO. Al-brasses show Cu_2O after oxidation at 183° C. for 10 min. At 400° C. ZnO is present together with an unidentified phase. The absence of Al_2O_3 lines is ascribed to the amorphous nature of this film. In the case of Mg and Mg alloys the film is that of cubic MgO when the temperature is 400°C. Below this the interpretation is difficult, but cubic MgO is probably present. Oxide films are generally orientated. The nature of the orientation is discussed. It is suggested that the plane with the highest density of metal atoms per unit area tends to lie on the polished surface. J. T.

4452. Structure of Potassium Hexachlorothalliate Dihydrate. J. L. Hoard and L. Goldstein. *J. Chem. Phys.* 3. *pp.* 645–649, *Oct.*, 1935.—$K_3TLCL_6.2H_2O$ is tetragonal with *a* 15·841, *c* 18·005 Å, and 14 molecules in the unit cell, space group D^{17}_{4h}–*I4/mmm*. Each Tl is surrounded octahedrally by 6Cl, forming $(TlCl_6)^{-3}$ ions ; $24K^+$ ions are each surrounded by $8Cl^-$, 16 each by $7Cl^-$ and $2H_2O$, and 2 each by $6H_2O$. Tl^{III} and Cl are united by covalent bonds, Tl-Cl = 2·55 Å. A complete structure has been deduced with 19 parameters. $Rb_3TlBr_6 \cdot 8/7$ (*not* 1) H_2O, with *a* 16·95, *c* 19·45 Å, probably has the same type of structure, the Rb coordinating $8H_2O$ instead of 6. [See Abstract 1933 (1935).] C. A. S.

4453. Solidification of Rock-Salt Crystals. J. Boros and Z. Gyulai. *Zeits. f. Physik*, 96. 5–6. *pp.* 355–358, *Aug.* 31, 1935.—The influence of temperature and time upon the solidification of molten rock-salt is investigated by observing the change of electrical conductivity. Measurements were conducted in the temperature range 140° C.–520° C. and show that the degree of solidification increases roughly linearly with time. J. E. R. C.

***4454. Camera for Determination of Identity Period in X-Ray Structure Analysis. F. Bakhmetiev.** *Techn. Phys., U.S.S.R.* 1. 4. *pp.* 370–375, 1935. *In English.*—The author gives a short description of a new camera facilitating the determination of the identity period of the space lattice in different directions in oblong samples. X-ray photographs are given of NaCl oscillating about the axes [100], [110], [111], [112], and of $FeAl_3$ about axes [010] and [011]. AUTHOR.

4455. Precision Determination of Lattice Constants. E. R. Jette and F. Foote. *J. Chem. Phys.* 3. *pp.* 605–616, *Oct.*, 1935.—The problem is, in general, the determination of small changes in lattice constants, particularly in alloys, due to changes in composition, or in the nature of the sample. These variations cannot be found directly, and thus the technique must provide readings of the lattice constants themselves with an accuracy of at least 0·01 %. Four problems are involved : a theoretical study of the diffraction camera, a method of calculation of results, experimental technique, adequate preparation of samples. The last-named leads to extremely careful annealing ; several months are sometimes required, or even a year to attain equilibrium has been reported. A series of 14 metals has been investigated. F. I. G. R.

4456. Kinetics of Decomposition of Solid Solutions of Si in Al. M. I. Zacharowa. *Zeits. f. Physik,* 96. 11–12. *pp.* 754–760, *Sept.* 18, 1935.—The alteration in the lattice constant and hardness of a deformed and recrystallised Si-Al alloy containing 1·5 % Si is examined for various annealing treatments and it is concluded that the decomposition of the solid solution of Si in Al is accelerated by plastic deformation. Isothermal decomposition of undeformed alloys at 218 and 280° C. occurs in 3 stages: (*a*) a latent stage, (*b*) a stage of spontaneous decomposition and (*c*) a period of growth and coagulation of crystallites. The Brinell hardness number reaches its highest value at the beginning of the third stage. H. J. H. S.

See also Abstracts 4553, 4584, 4614, 4621, 4624, 4627, 4667, 4704, 4715, 4740.

DENSITY.

***4457. Specific Gravity of Gases by Effusion. L. C. Kemp, Jr., J. F. Collins, Jr., and W. E. Kuhn.** *Indust. & Engin. Chem.* (*Analytical Edition*), 7. *pp.* 338–341, *Sept.* 15, 1935.—A study is made of the inherent defects of the effusion method of determining the specific gravity of gases, and it is concluded that below 1·30 they can be measured by this method provided proper precautions are taken. Among these, the orifice should be carefully made, and not burred, and a method of making satisfactory orifices is described. The plate should have a thickness less than 0·10 mm. and probably greater than 0·05 mm. The diameter should be about 0·240 mm. and not greater than 0·260 mm. Stainless steel is recommended as a satisfactory material for the orifice plate. G. E. B.

***4458. Gas Specific Gravity Balance. J. S. Hales and W. C. Moss.** *Journ. Sci. Instruments,* 12. *pp.* 309–313, *Oct.,* 1935.—An apparatus is described for the accurate and rapid determination of the specific gravities of gases in large or small quantitites, depending on the counterbalancing by riders of the change in upthrust on a glass bulb when surrounded successively by air and gas. A high degree of damping enables high sensitivity to be employed without loss of speed. Results of comparison with other types of apparatus show its accuracy to be one or two in the third decimal place over the range from H_2 to CO_2. AUTHORS.

See also Abstract 4633.

DIFFUSION AND OSMOSIS.

4459. Rate of Diffusion of Deuterium Hydroxide in Water. W. J. C. Orr and J. A. V. Butler. *Chem. Soc., J. pp.* 1273–1277, *Sept.,* 1935.—Measurements have been made of the diffusion coefficient of deuterium hydroxide (*ca.* 3 %) in water at temperatures between 0° and 45°, and from the results an estimate is made of the rate of self-diffusion in water. In neutral solutions the effect of the mobility of the hydrogen ions is probably negligible. It should be an observable quantity in a *N*-acid solution, but the effect is obscured by a decrease of the diffusion coefficient caused by the electrostriction of water by the ions. AUTHORS.

See also Abstracts 4628, 4633.

ELASTICITY AND PLASTICITY.

4460. Applications of an Electro-Elastic Analogy. M. Boni. *Ingegnere,* 9. *pp.* 682–684, *Sept.,* 1935.—An extension is given of the method developed by Frola [see Abstract 5067 (1933)] for determining tangential or shearing forces, and the reactions of the supports, in plane beams simply supported at the periphery. This method consists in utilising the analogy between shearing forces in beams and electric forces. A graphical method of calculation is employed and this can be applied in cases where an analytical method is practically impossible. J. J. S.

4461. Rectangular Plates Supported on Flexible Beams. E. H. Bateman. *Phil. Mag.* 20. *pp.* 607–610, *Oct.*, 1935.—Although the theory of flexure of rectangular plates carrying a uniformly distributed transverse load is well established for the case in which the edges rest freely on rigid rectilinear supports and for the corresponding case of clamped edges, the standard results are limited in value because of the assumption that the edge lines of the plate remain straight. Application of the theory is now made to the case where the plates are supported on flexible beams, and a solution is obtained in which the constants employed enable the edge deformations to be matched to the deformation curves of the supporting beams. The constants may be determined either by harmonic analysis or by balancing the deflections at different points along the edges. As an illustration of the accuracy which may be obtained by a first approximation, the method is applied to the case of a square plate clamped at the edges. H. H. Ho.

4462. P.V.T. Relations of the Liquid, and the Phase Diagram of Heavy Water. P. W. Bridgman. *J. Chem. Phys.* 3. *pp.* 597–605, *Oct.*, 1935.—The P.V.T. relations of both liquid D_2O and H_2O are measured between − 20° and 95° C. and up to 12,000 kg./cm^2, and the transition parameters of liquid and solid D_2O in the range between − 60° and + 20° C. and up to about 9000 kg./cm^2. An unstable modification of solid D_2O, for which the designation IV is proposed, is found in the field of stability of V. Reference to the original work on H_2O shows that the corresponding modification of H_2O also exists. In general the properties of H_2O and D_2O covered by these measurements are very much alike, and differ in the direction suggested by the greater zero-point energy of H_2O: the molar volume of D_2O is greater than that of H_2O at the same pressure and temperature, and the transition lines of D_2O run at higher temperatures. In finer detail, however, the differences do not vary regularly, and probably other considerations than of zero-point energy alone are necessary for a complete explanation. AUTHOR.

4463. Torsional Vibrations of Cylinders. Y. Nomura. *Tôhoku Univ., Sci. Reports,* 24. *pp.* 372–390, *Aug.*, 1935. *In English.*—The vibrations of an infinitely long cylinder produced by a periodic force uniformly applied to the periphery of a normal section are calculated, and the modifications introduced into the character of vibrations by changing the radius of the cylinder and the frequency of the applied force are fully discussed. AUTHOR.

4464. Vibration of an Incomplete Circular Ring. T. Ikebe. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers. No.* 589. *pp.* 244–262, *Sept.*, 1935. *In English.*—The frequency and form of vibration of an incomplete circular ring with a very small air-gap are calculated by Ritz's method and by an integral equation. Numerical values are given to the gravest and the next higher tones; the frequency of the latter decreases when the air-gap increases. Frequencies are tested experimentally by supporting a magnetised hardened steel ring by rubber cords and placing the opening in a coil carrying an alternating current. The magnetisation and frequency of vibration of the ring when in resonance are found for two widths of air-gap and the resonance frequency reduced to zero magnetisation. The theories are found to differ by about 1·9 % from the experimental results; it is thought that the calculations are in error due to the neglect of certain modes of vibration. H. M. B.

4465. Effect of Temperature on the Breaking Strength of Glass Rods. K. Mengelkoch. *Zeits. f. Physik*, 97. 1–2. *pp.* 46–63, *Sept.* 23, 1935.—When a glass rod is broken by an applied force which increases in strength with uniform velocity, the break appears partially as a plane "mirror," and partially as a serrated surface. The ratio of the smooth part to the other is seen to vary with the temperature at which the experiment is performed, being greatest at about 200° C. The actual breaking strength is found to be approximately the same at the same temperature, with whatever speed the force is applied, but depends on the condition of the rod such as scratching the surface. For both scratched and unscratched rods, the breaking strength is shown to be greatest at low temperatures (— 190° C.), decreases to a minimum at + 140° C., and then increases again at higher temperatures. Increasing the speed of the experiment and scratching the rod, tends to reduce the mean breaking strength. H. M. B.

***4466. Use of the Interferometer Strain Gauge in Photoelasticity. R. W. Vose.** *J. of Applied Mechanics*, 2. *pp. A*99–*A*102, *Sept.*, 1935.—By the use of any of the usual photoelastic methods the difference of the principal stresses and their direction at any point in a suitable loaded specimen are determined, and through a knowledge of Poisson's ratio their sum is obtained (and a solution made possible) by a measurement of the lateral deformation of the specimen by means of an interferometer strain gauge. This instrument, together with its accessories and their use, is illustrated and described in the paper. Examples of the problems solved by the use of the instrument show its accuracy and the consistency of the results obtained by the method. AUTHOR.

***4467. Variation with Temperature of Young's Modulus for Certain Metals. J. E. Calthrop and J. T. Miller.** *Am. Phys. Teacher*. 3. *pp.* 131–132, *Sept.*, 1935. A simple method, involving the loading of a metal ring through which a heating current is passing, is used for the determination of the load-depression curves at different temperatures. From these curves is found the constant K in the usual expression $E = /E_0 e^{-K\theta}$, where E is Young's modulus and θ is the temperature. Values of K for seven metals are given, including nichrome and manganin. AUTHORS.

***4468. Dynamic Methods of Determining Young's Modulus. J. M. Ide.** *Rev. Sci. Instruments*, 6. *pp.* 296–298, *Oct.*, 1935.—The sample, rod-shaped with the ratio dia./length $\ngtr$ 1/5 (which gives the modulus 0·5 % too high, but accurately if the ratio is $\ngtr$ 1/10), covered at one end with tin foil if non-conducting, forms one plate of a condenser, separated by a dielectric $\nless$ 0·1 $\ngtr$ 3 mm. thick, from the other plate (metal). Longitudinal vibrations are produced in the rod by an alternating voltage from a calibrated valve oscillator of variable frequency, and a direct polarising voltage is used to synchronise the condenser vibrations with the oscillator. Detection is by means of piezoelectric material, *e.g.*, Rochelle salt, cemented to or placed near the rod. Resonance may also be effected by a small piezoelectric crystal cemented to the rod and supplied with voltage from the oscillator. Results are accurate. C. A. S.

See also Abstracts 4663, 4717.

GRAVITATION.

4469. Isogravitational Surfaces. G. P. Gorchkov. *Bull. géodésique, No.* 43. *pp.* 119–126, *July–Aug.–Sept.*, 1934. *In English.*—The isogravitational surface is shown not to coincide with the isopotential surface; the angle between the normals to the two curves is derived. Application to the earth shows that this angle is about $11'\cdot 7$ at latitude 45°. The isogravitational surfaces are very close to spheres. Some of their properties are discussed; they have some importance in the interpretation of torsion balance observations. T. L. M.

See also Abstract 4487.

HYDRODYNAMICS AND AERODYNAMICS.

4470. Speed. B. M. Jones. *Roy. Inst., Proc.* 28. 4. *pp.* 633–654, 1935. *Nature,* 136. *pp.* 464–466, *Sept.* 21, *and pp.* 496–498, *Sept.* 28, 1935.—The two factors, track and power, which limit speed are discussed. The calculations due to Lanchester and Prandtl which differentiate the power essentially required for support from that required to drag an aeroplane through the air are described in a simplified form. The amount of extra power required for the elimination of the track problem is not such as to put a final limit upon speed. The resistance which has to be overcome merely to drag the aeroplane through the air does, however, limit the possible speed. The reasons are stated why streamlining is so effective in reducing head resistance. The difficulties underlying the structure of good streamline aeroplanes and possible ways of overcoming them are enumerated. Now that perfect streamlining is being approached, skin friction provides the dominating contribution to the resistance. The effect of turbulence in the boundary layer upon the ultimate limit of speed is of great importance practically. The accurate determination of the skin friction on the actual curved surfaces of an aeroplane and methods for the reduction of this friction are fundamental to the problem of speed.
G. F. P. T.

4471. Oscillations Caused by Motion of a Sphere Through Water. L. Marty. *J. de Physique et le Radium,* 7. *pp.* 373–382, *Sept.*, 1935.—The kinetic energy developed in fluids by the oscillations of solids and the decrease of the calming of the motion by these solids is determined experimentally. At first the " mass entrained " is obtained. The values found are compared with those given by the theory of perfect fluids and by Stokes' theory. For short periods the fluid can be treated as perfect; for long periods the mass entrained as determined experimentally differs from that given by Stokes' theory. The same theory yields values for the decrease of the oscillations less than those found by experiment.
G. F. P. T.

4472. Turbulent Mixing Regions Formed by Jets. A. M. Kuethe. *J. of Applied Mechanics,* 2. *pp. A*87–A95, *Sept.*, 1935.—The turbulent mixing of two jets of the same density is investigated theoretically by means of Prandtl's theory of turbulence. Tollmien's solution for the mixing region of a plane jet is extended to the general case of the mixing of two parallel streams of different velocities. The turbulent mixing region surrounding an axially symmetrical jet issuing into fluid at rest is considered and solved by the application of a new method of approximation. The proportionality factor for the mixing length which is the only empirical quantity in the theory is evaluated experimentally. Velocity fluctuations and profiles are measured in a jet by means of a hot-wire anemometer and a pitot tube, and agree well with theory and experiment. G. F. P. T.

KINETIC THEORY OF MATTER.

4473. Observation of Brownian Motion with the Unaided Eye. E. Kappler. *Phys. Zeits.* 36. *pp.* 643–646, *Oct.* 1, 1935.—A detailed explanation is given of the phenomena which occur when Brownian motion is observed with the unaided eye [see Abstract 2842 (1935)]. With the ultra-microscope the motion of the individual particles is revealed, but with the unaided eye time fluctuations in the brightness and colour of the surface elements of the preparation give an illusion of movement. The brightness and colour of each such element are determined by the diffracted rays collected by the eye from a group of particles acting as an irregular grating. The continual rearrangements of the particles in the group, owing to Brownian motion, are responsible for the effects observed. W. S. S.

See also Abstracts 4450, 4571, 4705.

MATHEMATICAL METHODS, THEORY OF MEASUREMENTS, UNITS AND DIMENSIONS.

4474. Asymptotic Properties of a Class of Contingent Variables. H. Cramér. *Comptes Rendus,* 201. *pp.* 441–443, *Aug.* 19, 1935.—For application of the classical theorem of Laplace-Liapounoff in the calculus of probabilities, it is important to examine more closely the manner in which the law of distribution of the contingent variable in question tends towards the law of Gauss. With this object the author has studied the asymptotic properties of the sums of contingent independent variables. It has thus been possible to place upon more rigorous foundations the theory of the series introduced into statistical mathematics by Bruns and Charlier. The majority of the results thereby derived are also of value for a certain class of contingent dependent variables of a continuous variable. An asymptotic expression has been derived for such variables. H. H. Ho.

4475. General Solution of a Class of Physical Problems. B. R. Seth. *Phil. Mag.* 20. *pp.* 632–640, *Oct.*, 1935.—The method of conformal transformation is applied to obtaining the general solution of Laplace's equation in two dimensions and satisfying given boundary conditions, the boundary consisting of straight lines only. J. S. G. T.

4476. Meaning of Probability. H. Dingle. *Nature,* 136. *pp.* 423–426, *Sept.* 14, 1935.—There are threee aspects of probability, *viz.*, the ordinary, everyday aspect, the mathematical aspect and the physical aspect. Probability in physics is purely symbolical; it is a metaphor expressing certain experimental results. The following problem is discussed: If A and D each speaks the truth once in three times independently, and A says that D lies, what is the probability that D speaks the truth? The author finds that the absolute probability, *i.e.*, the "likelihood" that D tells the truth is 4/27; the probability is 1/3. J. S. G. T.

4477. Fundamental and Derived Units. R. T. Birge. *Am. Phys. Teacher,* 3. *pp.* 102–109, *Sept.*, 1935.—The equation defining any electrical or other unit must contain a proportionality factor of an entirely arbitrary character as to both magnitude and dimensions. It follows that the dimensions of all derived units (mechanical, electrical, and magnetic) are also arbitrary, and are not fixed merely by the adoption of certain primary units. [See also Abstract 2753 (1934).] L. H.

MECHANICS, CLASSICAL.

***4478. Production of High Rotational Speeds. J. W. Beams and E. G. Pickels.** *Rev. Sci. Instruments*, 6. *pp.* 299–308, *Oct.*, 1935.—Methods of spinning rotors to very high speeds by means of compressed air are discussed. A detailed description is given of the construction of apparatus to spin rotors both in gases at various pressures and in a vacuum. Some uses of the apparatus and its operating characteristics are outlined. AUTHORS.

MECHANICS, QUANTUM.

4479. Dirac's Theory of the Spinning Electron and Non-Linear Field Equations. W. Wessel. *Zeits. f. Physik*, 96. 7–8. *pp.* 520–533, *Sept.* 7, 1935.—It is proposed to alter Dirac's equations, which correspond in classical theory to the constancy of the four-dimensional velocity, so that they should also contain the analogue of the classical result that four-dimensional velocity and acceleration are perpendicular. This is done by altering the term in Dirac's equations which involves the proper mass of the electron. The electric and magnetic field quantities which now enter into the equations can be shown, if Planck's constant be put equal to zero, to reduce to the potentials of Born's electrodynamics. G. C. McV.

4480. Problem of Three Centres. Part I. G. S. Gordadse. *Zeits. f. Physik*, 96. 7–8. *pp.* 542–545, *Sept.* 7, 1935.—The energy of an electron moving in the field of three protons is calculated by wave-mechanical methods. G. C. McV.

4481. Recent Quantum Theory of the Electron. V. Weisskopf. *Naturwiss.* 23. *pp.* 631–637, *Sept.* 13; 647–653, *Sept.* 20, *and pp.* 669–674, *Sept.* 27, 1935.—The following subjects are briefly presented: Schrödinger's wave-mechanical theory of the electron; the relativistic Schrödinger equation; electron spin; Dirac's electron theory; the "hole" theory of the positron; interaction between matter and the electromagnetic field. The intention is to present recent developments of electron theory without making too great demands upon the reader's knowledge of mathematics. J. S. G. T.

4482. Quantum Mechanical Calculation of Polarisability and of Dispersion Forces. H. Hellmann. *Acta Physicochimica*, 2. 3. *pp.* 273–290, 1935. *In German.*—The wave-mechanical dispersion forces first discussed by London play a great part in many chemical problems, since they are the weak though relatively far reaching forces which exist between electrically neutral and spherically symmetrical systems. Although the quantitative estimation of the dimensions of these forces is for many practical chemical problems impossible, yet an approach may be made from a consideration of molecular polarisability. In addition to the London estimation, two other methods are available and these form the subject matter of the present paper which is entirely mathematical. H. H. Ho.

4483. Quantum-Mechanical Description of Physical Reality. N. Bohr. *Phys. Rev.* 48. *pp.* 696–702, *Oct.* 15, 1935.—It is shown that a certain "criterion of physical reality" formulated by A. Einstein, B. Podolsky and N. Rosen [see Abstract 2411 (1935)] contains an essential ambiguity when it is applied to quantum phenomena. In this connection a viewpoint termed " complementarity " is explained from which quantum-mechanical description of physical phenomena would seem to fulfil, within its scope, all rational demands of completeness. AUTHOR.

4484. Foundation of Geometry in Microscopic and Macroscopic Space. T. Hosokawa. *Hiroshima Journ. Sci.* 5. *pp.* 141–149, *Aug.*, 1935. *In English.*—The paper develops the construction of a new geometry having its foundation on the proper qualities of geometry, and which, based on common and actual physical demonstrations and observations, will express mathematically the relations between physical realities. Since the new geometry is to be constructed on physical phenomena, the author reverses the conventional method of deriving microscopic space from macroscopic, and explains macroscopic from microscopic, the metrical conception of the latter being defined by the physical phenomena. The equations arrived at are those obtained in the extension of Dirac's equation to projective relativity [see Abstracts 69, 2348 and 3154 (1934)]. N. M. B.

4485. Wave Geometry. Geometry in Microscopic Space. K. Morinaga. *Hiroshima Journ. Sci.* 5. *pp.* 151–188, *Aug.*, 1935. *In English.* —According to Mimura [see Abstract 1985 (1935)] the expression for the metric in general microscopic space is $ds\,\psi = \gamma_i\,dx^i\,\psi$ where ψ is a 1–4 matrix given as a solution of the " unknown Dirac equation." The transformation which makes $ds\,\psi = 0$ invariant is composed of a coordinate, a spin, and a gauge transformation (C. G. S. transformations). These are equivalent to those in the ordinary spinor calculus except for the gauge transformation. The condition for which the coordinate transformation becomes Lorentzian is found to be a special case. The parallel displacement which makes $ds\,\psi = 0$ invariant corresponds to Weyl's parallel displacement in ordinary space. An investigation of this leads to an expression for the " unknown Dirac equation " in a fundamental form invariant for all C. G. S. transformations and represented by $\delta\psi/\delta x^m = (-\Lambda_m + 2T^5{}_m\gamma_5 + R_m I)\,\psi$. The case of Riemannian space is examined. The conditions of integrability of the fundamental equation in special cases and in the general case are deduced. One of the conditions for the simplest case significant in physical application is that $(\sqrt{\Delta}/2)\,\epsilon_{s\,t\,r\,q}\,K_{lm}^{\cdot\cdot\,rq} = \pm\,K_{lms\,t}$, where $K_{lm\,rq}$ is the Riemann curvature tensor. [See following Abstract.] N. M. B.

4486. First Approximate Solution of Morinaga's Equation: $(\sqrt{\Delta}/2)\,\epsilon_{s\,t\,r\,q}K_{lm}^{\cdot\cdot\,rq} = K_{lms\,t}$. T. Sibata. *Hiroshima Journ. Sci.* 5. *pp.* 189–203, *Aug.*, 1935. *In English.*—For Riemannian space, the general differential equation for ψ [see preceding Abstract] can be written in the form $\delta\psi/\delta x^m = (\Gamma_m + T^5_m\gamma_5 - L_m I)\,\psi$. In this paper, in order to apply the theory to the problem of gravitation, the case in which $T^5_m = 0$ and $L_m = 0$ is considered and the fundamental equation becomes $\delta\psi/\delta x^m = \Gamma_m\psi$, and the condition of integrability is given by Morinaga's equation, the solution of which is examined. N. M. B.

4487. Theory of Gravitation Based on Wave Geometry. Y. Mimura and T. Iwatsuki. *Hiroshima Journ. Sci.* 5. *pp.* 205–215, *Aug.*, 1935. *In English.*—In attempts to unify quantum mechanics and general relativity the generalised equations of the Dirac electron have assumed that Einstein's gravitational law is valid for microscopic gravitational phenomena such as occur in the case of the electron, neutron, proton, etc. In the present paper this doubtful assumption is avoided, and the law of the microscopic gravitational field is deduced on the basis of the new wave geometry of microscopic space; from this is found a new and more stringent macroscopic gravitational law from which is shown the existence of a gravitational wave closely resembling the electromagnetic wave. A schematic representation is given of the results, forming a gravitational unified field theory. N. M. B.

See also Abstracts 4438, 4538, 4581, 4597, 4694.

RELATIVITY AND ETHER.

See Abstracts 4479, 4484, 4485, 4486, 4487, 4694.

SOLUTION.

4488. Mutual Solubility of Heavy Water and Organic Liquids. J. Timmermans and G. Poppe. *Comptes Rendus*, 201. *pp.* 524–527, *Sept.* 23, 1935.—When H_2O is replaced by D_2O the critical solution temperature, t_c if "upper" rises, if "lower" falls. This is exemplified by detailed results with phenol, acetonitrile, and *n*-butyric acid with which the upper t_c rises by 12·25, 6·0 and 23·45° respectively, and by triethylamine for which the lower t_c falls by 3·80°. C. A. S.

4489. Solubility of Hydrogen in Molten Aluminium. L. L. Bircumshaw. *Faraday Soc., Trans.* 31. *pp.* 1439–1443, *Oct.*, 1935.—The solubility of H_2 in molten Al has been determined at 700°, 800°, 900° and 1000° C. and the volumes (N.T.P.) of gas dissolved are 0·23, 0·89, 1·87 and 3·86 c.c. per 100 gm. of metal respectively. The "saturated" heat of solution has been calculated and has been found to be 43,400 cal./gm. mol. of gas dissolved. AUTHOR.

See also Abstracts 4439, 4494.

SURFACE TENSION AND COHESION.

4490. Phase-Boundary Energies in Systems with Pure Electroneutral Phases. H. Hohn and E. Lange. *Phys. Zeits.* 36. *pp.* 603–624, *Sept.* 15, 1935.—A consistent and as far as possible deductive survey starting from the concepts of surface work and adhesion work, of the most important phase-boundary energies of simple polyphase systems having pure phases, with a discussion of their field of value and the importance of thermodynamic and empirical relations existing between them. P. H. B.

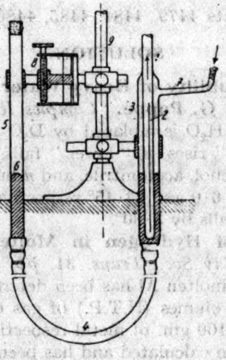
4491. Surface Tensions of Ternary Solutions. Parts I and II. J. W. Belton. *Faraday Soc., Trans.* 31. *pp.* 1413–1425, *Oct.*, 1935.—The surface tensions of aqueous solutions of NaCl and KCl, and of NaCl and HCl, were measured. The variation of the surface tension with the concentration of each component is discussed. The surface tensions of ethyl alcohol-water-salt and of acetic acid-water-salt mixtures were also measured. The results are discussed in relation to the Gibbs equation and the surface adsorption of water calculated. AUTHOR.

See also Abstract 4423.

VACUA, HIGH.

***4492. Speed of Divergent Nozzle Pumps. M. J. Copley, O. C. Simpson, H. M. Tenney and T. E. Phipps.** *Rev. Sci. Instruments*, 6. *pp.* 265–267, *Sept.*, 1935.—Calculations on the optimum nozzle dimensions based on turbine theory suggested that unusually long divergent nozzles would produce abnormally high speeds. This was tested for certain pumps made of glass and found to be true. Details of the design of the nozzles are given. G. E. B.

***4493. Valve for Fine Regulation of the Pressure of Gases, and its Application to Ionic Tubes. V. Kunzl and J. B. Slavik.** *Zeits. f. techn. Physik,* 16. 9. *pp.* 272–276, 1935.—The valve, which is shown diagrammatically in the figure, consists essentially of a tube 1 connected to the apparatus, sealed into a second tube 3 connected to the gas supply, and constituting one arm of a U-tube containing mercury. The tube 1 has in it a fine slit which permits the passage of gas, and whose length is regulated by the position of the mercury meniscus. The gas pressure is thus controlled through the action of the mercury meniscus. Various curves of the performance of the regulator are given. G. E. B.



VISCOSITY, FRICTION AND LUBRICATION.

4494. Viscosity of Aqueous Electrolyte Solutions. Part II. Comparison of the Specific Ionic Viscosities with other Ionic Properties of Homologous Elements. H. Tollert. *Zeits. f. phys. Chem.* 174. *Abt.A.* 3–4. *pp.* 239–246, 1935.—The specific dynamic ionic viscosities of the alkali metals and of the halogens are compared with 9 other ionic properties of these homologous series. Much the same course is followed by the lattice energies of the alkali chlorides or sodium halides, the ionic radii in the solid lattice, the hydration and heat of hydration (except for sodium), and, in the alkali metal series, the ionisation energies, as by the specific ionic viscosities in 0·1 *N* concentration. It is concluded that, up to this concentration, hydrated ions and the free water are in a state of equilibrium, which, as with other ionic properties, is a function of the order. [For Part I, see Abstract 1020 (1935).] T. H. P.

***4495. Rapid Precision Viscometer. O. Fitzsimons.** *Indust. and Engin. Chem.* 7. *pp.* 345–347, *Sept.* 15, 1935.—The accuracy of the Saybolt viscometer is compared on a theoretical basis with viscometers whose efflux time is linear with viscosity. Possible errors resulting from the use of Saybolt data to obtain the viscosity index of light oils are discussed. The Ubbelohde capillary viscometer is modified by the use of dual capillaries and by mounting the whole in a vapour bath. Thus greater operating speed is obtained than is afforded by the Saybolt instrument, along with the high inherent accuracy of capillary viscometers. AUTHOR.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***4496. Warped Mirrors. C. R. Burch and R. Beeching.** *Observatory*, 58. *pp.* 266–270, *Sept.*, 1935.—The authors describe an asymmetrical polishing stroke for mirrors showing a moderate departure from revolution symmetry. Zernike tests showed their procedure to be much more effective than the normal stroke. The stroke is not intended for cases of internal straining, where the mirror should not be persevered with. Arrangements for reducing the time necessary before testing can begin after each stage of polishing are also described. T. L. M.

***4497. Thin Mirrors for Reflecting Telescopes. H. C. King.** *Roy. Astron. Soc., Canada, J.* 29. *pp.* 228–230, *July–Aug.*, 1935.—It is asserted that a mirror of glass with less thickness than 1/8 its diameter will warp through its own weight. By experiment, the author shows that by supporting the whole area by a backing of pitch and wood, each of them 1 in. thick, he succeeded in figuring a mirror ½ in. thick and 9 in. dia., which has kept its figure without change through six months of constant use. Its great advantage over thick mirrors is that temperature troubles do not exist, the mirror from its thinness adapting itself quickly to changes. He gives a description of his methods. A. S. D. M.

***4498. Newer Telescopes. H. N. Russell.** *Scientific American, June*, 1935. *Roy. Astron. Soc. Canada, J.* 29. *pp.* 231–237, *July–Aug.*, 1935.—The author summarises recent progress in the elimination of coma, with a clear account of the Schwarzschild and Chrétien reflectors; and in securing high speed-ratios, with a description of the Schmidt camera and correcting plate. T. L. M.

See also Abstracts 4501, 4502.

COMETS AND METEORS.

4499. Strength of the Selective Radiation Pressure on Molecules in Comets' Tails. K. Wurm. *Zeits. f. Astrophysik.* 10. *pp.* 285–290, *Aug.* 31, 1935.—It is shown that the ratio of light-pressure to gravitational force for the CO^+ molecules in comets' tails can have any value between − 60 and − 120, and cannot be calculated more accurately. The average value from observation is − 99. G. C. McV.

4500. Meteor Spectra. P. M. Millman. *Harvard Coll. Obs., Ann.* 82. 7. *pp.* 149–177, 1935.—In continuation of a previous paper [see Abstract 3399 (1933)], 14 meteor spectra photographed in 1931–33 are here discussed. All show a bright-line spectrum with little or no continuous emission, and they fall into two groups: Type Y with H and K lines most prominent, and type Z without these lines. Y meteors appear above 80 km., and are stony; Z below this, and include probably both stony and iron meteors. The differences of spectrum probably are due to the kind or degree of excitation producing the light; and greater geocentric velocities seem to be correlated with higher degrees of excitation. It is significant that the average height of the lower ionised layer in our atmosphere, the maximum intensity of aurorae, noctilucent clouds, persistent meteor trains, and the greatest number of meteors, all occur between altitudes of 80 and 120 km. The Leonids are all of type Y, therefore stony meteors.

The problem of bursts in a meteor trail is complex; and impact radiation seems to favour the appearance of calcium in the spectrum. M. A. E.

LATITUDE AND LONGITUDE.

***4501. Meridional Instrument with Optical Self-Registering Micrometer. E. Chandon, E. Bouty and A. Gougenheim.** *Bull. géodésique, No.* 44. *pp.* 259–265, *Oct.–Nov.–Dec.,* 1934.—Improvements in the construction and method of use of this instrument are detailed with examples of its application. [See Abstract 4908 (1934).] C. A. S.

4502. Problem of "High Latitudes." H. S. Jelstrup. *Bull. géodésique, No.* 44. *pp.* 274–278, *Oct.–Nov.–Dec.,* 1934.—The relation between an error in measurement of a distance along a line of latitude and the azimuth, a, and latitude, ϕ, of the place concerned ordinarily involves the values of tan ϕ and sec ϕ, both of which tend to infinity as the pole is approached. It is shown that errors in azimuth, Δa, $\Delta a'$ at two points in latitudes ϕ, ϕ' are in the relation $\Delta a/\Delta a' = \cot\phi/\cot\phi'$. [See Abstract 4909 (1934).] C. A. S.

NEBULÆ.

4503. Magnitudes of Bright Galaxies in Como-Virgo Group. C. K. Seyfert. *Harvard Coll. Obs., Circ. No.* 403. [11 *pp.*], 1935.—A test of the accuracy of the focal method [see Abstract 4887 (1932)] by comparing the magnitude so derived with those of 82 bright Como-Virgo galaxies, by plates taken a short distance out of focus with small scale telescopes, the images of the stars and galaxies being compared in a Schilt photometer, the whole image being included within a diaphragm. Four tables and two diagrams are given. The author finds a mean error of a final magnitude in the 4-in. Ross and 1½-in. Cooke as $\pm\ 0^{m}\cdot08$ and $\pm\ 0^{m}\cdot06$. Compared with the Shapley and Ames method, galaxies fainter than $11^{m}\cdot0$ give a systematic difference of $0^{m}\cdot04$, those brighter than $11^{m}\cdot0$ do not agree. The focal comparison of stars and galaxies in small scale plates seems reliable.

A. S. D. M.

STARS.

4504. Spectrophotometric Parallaxes of 533 G and K Stars. F. Becker. *Zeits. f. Astrophysik,* 10. *pp.* 311–322, *Aug.* 31, 1935.—It is known that the intensity of the CN bands in certain spectral types of stars is correlated with absolute stellar magnitude, and the relation of the band at 416$m\mu$ has been found for stars of class G4 to K2, using recently published material which includes many southern stars. With this criterion, the absolute magnitudes, hence the parallaxes, of 533 stars in the Kapteyn areas 92 to 163 have been determined. M. A. E.

4505. New Orbit for 29 Canis Majoris. W. J. Luyten and E. G. Ebbighausen. *Astrophys. J.* 82. *pp.* 246–251, *Oct.,* 1935. A new orbit for 29 Canis Majoris has been derived from 24 plates taken at the Yerkes Observatory. The elements as calculated from the absorption lines are found to be essentially the same, except for the eccentricity, as those determined by Harper in 1917; especially there appears to be no observable change in ω. In agreement with what has been found in other stars of similar spectral class, the emission lines of He II and N III show a persistent displacement toward the red of about 100 km./sec. with respect to the absorption lines. AUTHORS.

4506. Establishment of Red Standards by Photographic Methods. Cecilia P. Gaposchkin and S. Gaposchkin. *Harvard Coll. Obs., Ann.* 89. 5. *pp.* 93–101, 1935.—A study of the new fast red plate which gives greater speed and base line than the older isochromatic plate. The authors used the Eastman I-C special plates with a Ciné red filter, they determined the red magnitudes by a 12-in. Metcalf refractor and a continuously calibrated aluminium objective grating, the calibration being carried out both directly and indirectly, and showing no appreciable change in grating constant with effective wave-length; magnitudes of red standards for the brighter North Polar sequence are given; the precision of the red magnitudes is smaller than of the blue; but the blue-red indices' precision equals (about) that of the blue-yellow. The red magnitudes so found will be most useful in discovering very red stars and for estimating the colours of faint variables, but will not be of much use in the routine discovery of variables. [See following Abstract.] A. S. D. M.

4507. Colour Indices of Giants and Dwarfs. Cecilia P. Gaposchkin. *Harvard Coll. Obs., Ann.* 89. 6. *pp.* 105–115, 1935.—From the blue-yellow magnitudes in the North Polar sequence, the author finds the relationship between the International system (I Pv) and the Harvard photo-visual system (H Pv) as $IPv - HPv = 0{\cdot}04 + 0{\cdot}10\,C$ where C is the colour index (IPg–IPv) C is tabulated for various spectral classes of giants and dwarfs separately, and these are compared with colour indices from other sources. The relation of the new Harvard photo-red system (H Pr) [see preceding Abstract] to H Pv is found and average red colour indices are tabled for several spectral classes and compared with those expected. The colours of faint red stars in several regions are tested by similar faint red stars in the North Polar sequence. A. S. D. M.

4508. Absorption Continuum at $\lambda 4227$ in M-Type Dwarf Stars. B. Lindblad. *Astron. Iakttagelser och Undersökning. Stockholms Obs.* 12. 2. [22 *pp.*], 1935. *In English.*—Between $\lambda 4227$ and the G-band is a kind of depression in the energy curve in the spectrum of M-type dwarf stars, which forms a useful criterion of absolute magnitude. This region has been investigated, comparing spectra of a typical M giant and a typical M dwarf, with a view to discovering the physical cause of the phenomenon. It is suggested that it is due to a wide absorption continuum at the resonance line of Ca, $\lambda 4227$, forming heavy unsymmetrical wings of this line, and that this explains the anomalous behaviour of *c* in the late type dwarfs. Other lines in the spectra of the two stars are also considered, and the energy curves over a wider interval are compared. The intensity and the asymmetry of $\lambda 4227$ should be studied in still fainter dwarfs. M. A. E.

4509. Absorption Lines Due to an Expanding Star. O. C. Wilson. *Mt. Wilson Observat., Contrib. No.* 526. *Astrophys. J.* 82. *pp.* 233–245, *Oct.*, 1935.—The modification of the shape of an absorption line produced by an expansion or contraction of a star is investigated. It is shown that Carroll's approximation is valid only for small velocities and that for large velocities important changes in the shape and strength of a line occur. Applications to giant stars and Cepheid variables are discussed briefly and to Wolf-Rayet stars and Novae with more detail. A method is indicated by which, if the geometrical explanation of certain features in the spectrum of Nova Herculis is considered valid, the linear dimensions of the star may be computed. A preliminary calculation gives for the radius of the photosphere of Nova Herculis in its earlier stages a value of the order of 100 × 10^6 km. AUTHOR.

4510. Effect of Reflection upon the Profiles of Absorption Lines in Spectroscopic Binaries. E. L. McCarthy. *Astrophys. J.* 82. *pp.* 261–267, *Oct.*, 1935.—The unsymmetrical profiles of absorption lines caused by axial rotation and reflection in close spectroscopic binaries were computed for a_2 Vir, V_2 Pup, and u_2 Her. The resulting errors in the radial velocities were evaluated for various phase angles. At quadrature they are approximately 2 km./sec. for a_2 Vir; 18 km./sec. for V_2 Pup; and 14 km./sec. for u_2 Her. AUTHOR.

4511. Thermodynamic Equilibrium in Atmospheres of Early-Type Stars. O. Struve. *Astrophys. J.* 82. *pp.* 252–260, *Oct.*, 1935.—The relative intensities of high-level and of low-level O II lines, in B and O stars, change with temperature. An application of the Boltzmann formula gives reasonable differences of temperature. The intensities of He I lines show variations which are contrary to Boltzmann's formula, and Rudnick has shown that this effect cannot be explained by turbulence. It is suggested that the He anomaly results from an accumulation of atoms in the triplet system, the lowest term of which is metastable. Such an accumulation is possible if there are departures from thermodynamic equilibrium, *e.g.*, if the photospheric radiation is appreciably diluted in the absorbing atmosphere. Departures of this nature are not improbable in the giants of early type. AUTHOR.

4512. Phase Lag in Cepheid Variables. G. Tiercy. *Arch. des Sciences*, 17. *pp.* 179–196, *May–June, and pp.* 255–288, *July–Aug.*, 1935.—The elementary pulsating sphere theory does not account for the lag of the magnitude variations with reference to the variation of radius. If the ratio of the radius of each layer to its minimum radius is at each instant constant for all layers, the pulsation is uniform, and no lag can occur. If this ratio goes through the same variations for all layers, but the time at which each stage is reached varies for different layers, the pulsation is homologous and a satisfactory expression of the lag can be obtained. The paper is devoted to a full discussion of the functions which arise in the mathematical treatment of these two cases. T. L. M.

4513. Spectrographic Observations of α-Cygni. G. F. Paddock. *Lick Observat., Bull. No.* 472. *pp.* 99–107, 1935.—From observations at Mt. Hamilton in 1931–33 it is found that α Cygni gives a continuously varying radial velocity apparently of non-periodic character, and is perhaps the first definitely established instance of such variation. A table is given for 399 dates and the weighted mean is − 3·1 ± 0·08 km./sec., also a chart. From June, 1931, observations on 34 successive nights were made which gave the usual spectroscopic binary curve, but this was never repeated. An apparent wave in an interval of about 2/10 days, probably originates in the unsteady state of the star's atmosphere. The star possibly possesses the characteristics of a Cepheid, but with only very small (if any) variation of light. [See following Abstract.] A. S. D. M.

4514. Pulsation in Stellar Atmospheres. E. A. Fath. *Lick Observat., Bull. No.* 474. *pp.* 115–119, 1935.—An attempt to find some physical change showing a correlation with the variation of light in stars. Example (1) α Lyræ. The author made 20-minute interval observations simultaneous with those made by Neubauer [see following Abstract] in 1933, Sept. 27, and 1934, June 15 and July 11. The two latter nights show correlation, the maximum light corresponding with maximum negative velocity, etc.; the earlier night slightly confirms this. (2) β Canis Majoris. Observations on 10 nights give similar results, and confirms a real variation of about 0·03 magnitude. (3) α Cygni [see preceding Abstract]. There is again a correlation between radial velocity and light, maximum light coming slightly before maximum velocity. There is also evidence of irregular variation. The fluctuations in all, can be explained as atmospheric pulsations. α Cygni may change its radius through a range of 4,700,000 km.; β Canis Majoris through from 80,000 to 100,000 km.; and α Lyræ through 4,000 km. A. S. D. M.

4515. Radial Velocity of α Lyræ. F. J. Neubauer. *Lick Observat., Bull. No.* 473. *pp.* 109–113, 1935.—The data from 133 spectrograms, taken at the Lick Observatory in 1931, 1933 and 1934, and 16 additional ones in 1900–1934, are given in a table, and are used to investigate the reality of a 0·19 day period. But the author concludes that there is no evidence of variation in velocity (greater than about 0·2 km./sec.) during an interval of 5 hr. in one night, greater than instrumental errors, and that the radial velocity of α Lyræ is constant within a small fraction of 1 km. [See preceding Abstract.] A. S. D. M.

4516. Photometric Elements of Boss 5070. G. E. Kron. *Astrophys. J.* 82. *pp.* 225–232, *Oct.*, 1935.—The light-variation of Boss 5070 has been observed over a period of seven years, from 1923 to 1930, with the photoelectric photometer of the Washburn Observatory, Because of the length of the period, 12·4 days, and the shallowness of the minima, it was necessary to take a large number of readings over a long interval of time before enough data were at hand to determine a satisfactory light-curve. The system is composed of a large B2 star with a smaller companion of greater surface intensity. The B2 star, because of its size, gives out so much more light than its companion that only one spectrum is visible. The minimum light-ratio and the large eccentricity of the orbit combine to remove to a large extent the indeterminateness of a solution based upon eclipses of only a tenth of a magnitude. AUTHOR.

SUN.

4517. Theory of Solar Corona. K. O. Kiepenheuer. *Zeits. f. Astrophysik*, 10. *pp.* 260–278, *Aug.* 31, 1935.—The corona is regarded as a gaseous shell, strongly ionised but in the mass electrically neutral. It is shown that the rising gases will retain for some time the magnetic field which obtains at the sun's surface. The author investigates the motion of such magnetised gaseous structures in the solar magnetic field and in that of the corona itself, and finds extensive agreement with the observed coronal rays in the case where only the coronal field is effective. This involves a complete screening of the solar field, for which confirmation is drawn from prominence motions. The theoretical minimum velocity for coronal rays also agrees well with the maximum recorded prominence velocity. Other consequences of the theory are developed. T. L. M.

4518. Equivalent Breadths of Fraunhofer Lines in the Sun's Spectrum. G. F. W. Mulders. *Zeits. f. Astrophysik*, 10. *pp.* 297–310, *Aug.* 31, 1935. *In English.*—The equivalent breadths are given of 462 Fraunhofer lines, distributed over eight different regions of the spectrum of the centre of the sun's disc. With the aid of these measurements, a calibration in equivalent breadth is given of Rowland's scale of intensities for solar lines, ranging from 3900 Å to 8600 Å. AUTHOR.

GEOPHYSICS.

GEODESY.

4519. Test of Approximate Formula for Rapid Computation of Warping of the Geoid. F. W. Darling. *Bull. géodésique, No.* 44. *pp.* 266–273, *Oct.–Nov.–Dec.,* 1934. *In English.*—The formula $H_R = 3\sigma dH/4\rho a$ [see Abstract 763 [1931)] has been tested with $a = 6371\cdot 2$ km., $d = 96$ km., $\sigma = 2\cdot 67$, $\rho = 5\cdot 5168$ (which gives $H_R = 0\cdot 00547H$), $H = h + 1400$ m. on land, and 1400 m. $- 0\cdot 615h$ on water; h was determined by averaging the height (or depth) over a circle of radius 213 km. around each of 22 stations in the U.S.A., and 9 on the oceans. The average discrepancy from the " true " value of H_R is $1\cdot 7$ m. (*i.e.*, $18\cdot 7$ %), the greatest 4 m. in two cases. With less detailed maps and a less experienced reader the discrepancies averaged $\ngtr 2\cdot 7$ m. C. A. S.

See also Abstracts 4501, 4502.

GEOPHYSICS, APPLIED.

4520. Dielectric Constants and Specific Resistance of Rocks. B. Dostovalov. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 3. 2. *pp.* 87–90, 1935. *In English.*—The rock specimen, a rectangular plate, is inserted between the plates of a condenser in a tuned circuit coupled to a valve oscillator giving frequencies between 6×10^5 to $2 \times 10^6 \sim$. From the change in capacity of a standard condenser necessary to restore resonance after the introduction of the specimen, and the ratio of the currents in the circuit at resonance, the dielectric constant and the resistivity of the specimen are determined. In all cases dry rocks were used, and the dielectric constant varied from 4–40, and the resistivities were of the order of 10^6 ohm. cm. The results did not show any relation between the measured values and the chemical composition of the rocks, but the texture seems to influence the dielectric constant. J. M. B.

HYDROSPHERE, PHYSICS OF THE.

4521. Propagation Path of Sea Waves Originated by Earthquakes (Tunami). M. Nakano and J. Nakagawa. *Geophys. Mag., Tokyo,* 9. *pp.* 215–221, *Sept.,* 1935. *In English.*—A general expression for the path of such a wave is deduced on the assumption that the time taken to reach a given point is a minimum. This is simplified by assuming the isobathymetrical lines to be parallel to the coast line, and applied to the wave recorded at Tukihama (Sanriku) as a result of the earthquake of March 3, 1933, which originated some 22 km. from the coast at a depth of about 7000 m. The time taken is calculated as 50 min. $8\cdot 3$ sec., compared with the recorded 47 min. C. A. S.

4522. Effect of Prevailing Winds on the Depth of Bays. M. Nakano. *Geophys. Mag., Tokyo,* 9. *pp.* 224–235, *Sept.,* 1935. *In English.*—The results obtained previously on small bays are here applied to one much larger. For small bays $F(r) = Ar$, where A is a constant but for larger bays it is more appropriate to put $F(r) =$ constant or to use $f(s) = \cos(\theta - \theta_0)$ to represent the effect of prevailing winds. The effect of topography appears to decrease as the area of the bay increases. The phase of undulation is explained, and an explanation based on Ekman's theory of drift current is proposed. The anomalies of depth distribution can be represented by the equation given earlier and for some more or less conspicuous anomalies provisional explanations are given. R. S. R.

See also Abstract 4527.

LAND, PHYSICS OF THE.

4523. Testing a Theory of the Earth's Interior. R. A. Daly. *Washington Acad. Sci., J.* 25. *pp.* 389–399, *Sept.* 15, 1935.—The model suggested consists of (*a*) a crystalline crust 60–75 km. thick, elastic and of considerable strength; all below is of temperature $>$ 1400°, elastico-viscous and of no strength, made up of (*b*) a vitreous basaltic stratum $\ngtr$ 400 km. thick, density 2·8–2·85, underlain by (*c*) 2300 km. of more basic vitreous silicates, density 3·5–6·5, with (*d*) a core, probably of iron, density 10·5–12·5. It is shown that such a model is consistent with the great rigidity of (*c*), that the elliptical form of the equator is doubtful, that elastico-viscosity below 100 km. is not inconsistent with deep foci earthquakes, that peneplains do not necessarily imply strength in the deeper shells, and that more detailed surveys are breaking up the apparently extensive areas of gravity anomaly of one sign thus affording no evidence of rock loads beyond the strength of the crust. Lastly the model is supported by post-glacial crust adjustments, the "shadow-zone," and the explanation afforded of petrogenesis, orogeny and crust warping. C. A. S.

See also Abstract 4520.

METEOROLOGY.

4524. Atmospheric Ozone. G. Lovera. *Com. Geod. e Geofis., Boll.* 3. *pp.* 153–169, *July*, 1935.—A discussion is given of recent work on O_3 in the atmosphere. The chief points considered are: (1) Absorbing property of the O_3 in the ultra-violet, visible, and infra-red. (2) Atmospheric absorption. (3) Methods of measuring the total O_3, and its distribution in the atmosphere. (4) The O_3 of the strata near to the earth's surface. (5) Variations with time and place, of the distribution of O_3 as regards latitude, high altitudes and in strata near the earth's surface. (6) Hypotheses on its formation and dissociation. A Bibliography of the subject is added. J. J. S.

4525. Transfer of Heat and Momentum in the Lowest Layers of the Atmosphere. A. C. Best. *Meteorolog. Office, Geophys. Mem.* 7. *No.* 65. [66 *pp*], 1935.—Using observations made on Salisbury Plain, curves were constructed to show the diurnal variation for each month of temperature differences between the heights of 2·5 and 30 cm., and 30 cm. and 1·2 m. These values were combined with earlier ones and temperature-height curves were constructed for clear summer days. The times of maximum temperature and the diurnal ranges of temperature at heights from 2·5 cm. to 17·1 m. are discussed. These results are used to obtain the variation of the coefficient of eddy conductivity with height. The vertical gradient of wind velocity between 2·5 cm. and 5 m. was measured and the effects of vertical temperature gradient and of wind velocity upon it are considered. The applicability of a "power law" to the variation of wind velocity with height near the ground is discussed and the effects of various factors upon the index in the power law. From measurements of the instantaneous wind velocity, the ratio of the eddy velocity to the mean velocity was calculated and the variation of this mean fluctuation ratio with height velocity, and vertical temperature gradient and the relative frequency of different sized fluctuations are examined. Finally gustiness in the lateral and vertical directions was investigated and the effects of height, vertical temperature gradient, and velocity upon gustiness are considered. The magnitudes of eddy velocities are deduced and the influence of these factors upon them. The accuracy to be expected in wind measurements with the air meter is given. R. S. R.

4526. General Circulation of the Atmosphere. H. Arakawa and S. Ooma. *Geophys. Mag., Tokyo,* 9. *pp.* 195–210, *Sept.,* 1935. *In English.*—The distribution of the air temperature over the earth's surface is expressed by a series of spherical harmonics, and the mode of circulation of the atmosphere corresponding to the harmonic functions of the 2nd and 4th orders is treated. Instead of a single circulation between the equator and either pole two smaller zonal circulations giving a southerly current from the equator and a northerly current from the pole below, and an opposite flow above, or a reversal of this system. The centres of circulation are at latitudes 35° 16′ and 47° 5′. [See also Abstract 2471 (1935).] R. S. R.

4527. Observations of Mean Sea Level and Climatic Cycles. J. Legrand. *Comptes Rendus,* 201. *pp.* 509–511, *Sept.* 16, 1935.—The curves previously given [see Abstract 1535 (1935)] are repeated and compared with similar curves giving rainfall at St. Louis, Mauritius, and Antananarivo, and mean sea level at Brest, with also curves showing sunspots, and comparing sea levels at Brest and Marseilles. There appear to be no connections or regularities traceable between the various phenomena, save that rainfalls at Dakar and Antananarivo appear to vary in exactly opposite fashion. Prevot's results [see Abstract 3287 (1929)] are not confirmed. C. A. S.

4528. Analysis of Fluctuations of Annual Rainfall. W. R. Baldwin-Wiseman. *Roy. Meteorolog. Soc., J.* 61. *pp.* 427–432, *Oct.,* 1935.—Records from 1114 stations, each covering at least 30 years, and 20 covering over 100 years were used and the mean, maximum and minimum annual rainfalls for the whole period were extracted. The range is given in inches and expressed as a percentage of the mean. Percentage departures are greater at dry than at wet stations. The 35-year period is adequate in some cases to give the longer mean but fails in others. Residual mass curves were prepared in the case of the longest records. R. S. R.

4529. Light of the Night Sky. J. Cabannes. *Helv. Phys. Acta,* 8. 5. *pp.* 405–420, 1935.—The author discusses the results obtained by using a spectroscope having large dispersion and a large aperture and gives details of the wave-lengths identified in the regions (1) 5000–8000 Å, and (2) 3800–5100 Å. He identifies bands of N_2, O_2 and H_2O. These vary in amplitude with a minimum when the earth is in the plane of the solar equator and a maximum when it has the maximum hetrographic latitude. The night sky illumination is attributed fractionally as (1) 0·45 by diffusion of solar radiation, (2) 0·30 by rays from feeble stars, and (3) 0·25 from luminosity of the higher atmosphere. The luminous layer is at a height of 200–500 km. with the green ray a little lower than the blue. He considers that fast electrons from the sun ionise the highest atmospheric layers and the secondary electrons produced, move in the earth's magnetic field and penetrate to, and illuminate, lower layers. He explains the formation and state of the molecules or atoms of N_2, O_2 and H_2O which give rise to the many bands and lines seen. R. S. R.

***4530. Humidity Slide Rule. E. G. Bilham.** *Journ. Sci. Instruments,* 12. *pp.* 318–322, *Oct.,* 1935.—A description is given of a slide rule for the computation of vapour pressure, dew-point, relative humidity and moisture content from readings of dry-bulb and wet-bulb thermometers under different conditions of aspiration. The slide rule can also be used for the solution of various hygrometric problems which arise in connection with meteorology and air-conditioning. AUTHOR.

See also Abstract 4620.

SEISMOLOGY.

4531. Seismic Vibrations of a Structure. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 13. *pp.* 681–714, *Sept.,* 1935. *In English.*—Expressions are obtained for the motion of (1) a simple structure subjected to incident longitudinal waves and the free vertical vibrations set up in it, and (2) a tall structure with rigid floors subjected to incident transverse waves and the free horizontal vibrations set up in it. The distribution of bending moments is also found. The structures investigated are those with (1) rigid floors and clamped base, (2) flexible floors and clamped base, and (3) rigid floors and hinged base, and for each one, two or three stories are considered. The assumption in an earlier paper regarding the movement of the lower end or foundation of a structure is only partially correct and it is shown that owing to the dissipation of vibrational energy into the ground, the amplitudes of vibrations of a structure do not exceed a certain limit even under resonance conditions and the same holds for the bending moments in any member of the structure. This supplies the information relating to the strength necessary in the earthquake-proof construction of a structure, which is liable to be subjected to resonating seismic vibrations. R. S. R.

4532. Propagation of Love Waves over a Semi-Infinite Solid Body of Varying Elasticity. S. Sakuraba. *Geophys. Mag., Tokyo,* 9. *pp.* 211–214, *Sept.,* 1935. *In English.*—On the assumption that the displacement perpendicular to the free surface and the dilatation are both zero, and the rigidity, μ, is related to the depth, z, by $\mu = \mu_0 (1 + \sigma z)^2$, σ being a positive quantity, the case is first considered of a surface wave along a semi-infinite surface boundary, of which the upper side is closely connected with a rigid body. Thence the condition necessary for the existence of Love waves (characterised by an infinitely large number of nodal planes) over a semi-infinite solid body of varying elasticity is deduced. C. A. S.

See also Abstract 4521.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

4533. Birkeland-Störmer Theory of Aurora. K. O. Kiepenheuer. *Zeits. f. Astrophysik,* 10. *pp.* 279–284, *Aug.* 31, 1935.—It is shown that the movement in the earth's magnetic field of corpuscular radiation which is in the mass neutral may be described by the Störmer equations when the density is sufficiently small (up to $1/cm^3$.). For greater densities the work of Chapman on the theory of magnetic storms leads to paths not consistent with the production of aurora. The penetration of the earth's atmosphere by the radiation considered is estimated, and plausible velocities of about 10^8 cm./sec. give agreement with observation. T. L. M.

RADIOACTIVITY.

4534. Radioactivity of Potassium and Rubidium. K. Sitte. *Zeits. f. Physik,* 96. 9–10. *pp.* 593–599, *Sept.,* 12, 1935.—Klemperer's suggestion that positrons should be emitted as well as β-particles if the β-radioactivity of K and Rb was due to the rare isotopes K^{40} and Rb^{86} was tested with an expansion chamber. No positron track was found in 200 electron tracks and on this and theoretical grounds the β-activity is attributed to the unknown and rare isotopes K^{43} and Rb^{87}. F. C. C.

4535. Branching Ratio of the Actinium Family of Radioactive Elements. M. Francis and Tcheng Da-Tchang. *Phil. Mag.* 20. *pp.* 623–632, *Oct.,* 1935.—The branching ratio of the actinium family has been determined for three different minerals, and found to be constant. The same result is obtained, whether Ta or Zr is used to precipitate the protactinium. The mean of seven determinations of the branching ratio is 4·05 ± 0·1 %. AUTHORS.

4536. β-Rays of Polonium. W. Bothe. *Zeits. f. Physik,* 96. 9–10. *pp.* 607–611, *Sept.* 12, 1935.—Using a fixed-focus β-ray spectrometer and a tube counter, the author has carried out a survey of the secondary β-ray spectrum of Po. Three distinct lines and two faint lines were found. The energies of the β-rays are given, together with those of the corresponding γ-rays, on the assumption that the β-rays arise from internal conversion in the K-level of Pb^{206}. W. E. P.

4537. β-Rays of Actinium. D. E. Hull, W. F. Libby and W. M. Latimer. *Am. Chem. Soc., J.* 57. *pp.* 1649–1652, *Sept.,* 1935.—The detection of the β-rays of Ac has been accomplished through the use of the screen-wall tube counter. The Ac, in a body of rare earth chlorides, was carefully purified by co-precipitation methods and mounted in a very thin layer on a cylinder around the counter. Effects of several hundred counts per min. were easily obtainable. The radiation is half absorbed in 0·0023 gm./cm^2. of Al. It is easily deflected away from the counter when it is placed in a magnetic field. The maximum energy of the β-particles is about 220,000 eV, which value fits well on the lower Sargent curve. The radiation has been positively identified as due to Ac itself by the excellent agreement between theoretical and experimental growth curves. AUTHORS.

See also Abstracts 4434, 4658, 4709.

RADIATION.

ABSORPTION AND TRANSMISSION.

4538. Theory of the Metallic Absorption of Light. T. Muto. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 585. *pp.* 179–194, *Sept.*, 1935. *In English.*—Develops the wave mechanics theory of "secondary quantum absorption" of light in metals, which consists of one photon absorption with the simultaneous absorption or emission of one lattice quantum and gives rise to the observed weak absorption of light in the red end of the spectrum. Expressions are obtained for the absorption coefficients due to elementary processes of the kind mentioned, showing the frequency and temperature dependence of the absorption. W. S. S.

4539. Short Exposure Method of Measuring Light of Low Intensity. M. v. Ardenne and E. Haas. *Zeits. f. phys. Chem.* 174. *Abt.A.* 2. *pp.* 115–121, 1935.—An arrangement is described which allows of the measurement of light intensities of 7 × 10^{-11} cal./sec. to within ± 1 % with an exposure time of 1 sec. Use is made of a photo-cell, the current from which produces in a high coupling-resistance (over 10^8 ohms) potential gradients which, with the aid of an amplifier, act on normal needle measuring instruments. The method is applicable to the measurement of the absorption of light by bacterial pigments. T. H. P.

***4540. Optimum Grain Size in the Christiansen Filter. H. S. Denmark and W. M. Cady.** *J.O.S.A.* 25. *pp.* 330–331, *Oct.*, 1935.—The width at half-maximum of the band transmitted by a Christiansen filter has been measured for ten wave-lengths and for glass grains of six sizes in ethyl salicylate. With a cell 7·5 mm. thick, the grain size affording the narrowest bands was found to be about 0·7 mm., depending somewhat upon wave-length. Bands have been observed in the violet, having a width at half-maximum as narrow as 8 to 10 Å, the transmission at peak being about 40 %. AUTHORS.

COLORIMETRY.

***4541. Development of a Photoelectric Colorimeter. T. W. Schmidt.** *Zeits. f. Instrumentenk.* 55. *pp.* 336–346, *Aug., and pp.* 357–367, *Sept.*, 1935.—The colorimeter is designed to measure the absorption of monochromatic light by a substance in solution. The source consists of a gas discharge lamp in conjunction with a suitable filter to isolate a particular line. The lamp is mounted in a vertical opaque tube which can be rotated so that the light issuing from an aperture in the side of the tube is made to pass through one of three glass cells containing liquids under test. The light sensitive element, a selenium blocking-layer cell, is mounted opposite the aperture in the lamp tube and moves round as the latter is rotated. Thus the three glass cells can be interposed in turn between the aperture in the lamp tube and the selenium cell. The photoelectric current is measured by means of a galvanometer built in the base of the colorimeter. An adjustable screen in the lamp tube aperture enables a full scale reading to be obtained with the pure solvent cell in position, so that the extinction (logarithm of the ratio of the transmission of the solvent to that of the solution) can be read off directly on substituting the solution cell. The errors in the extinction due to errors of reading and lack of strict monochromacy are considered in some detail. For an extinction of 0·2 the extinction error is found to equal about 0·4 %.

W. S. S.

***4542. Photoelectric Colorimeter with Logarithmic Response. R. H. Müller and G. F. Kinney.** *J.O.S.A.* 25. *pp.* 342–346, *Oct.*, 1935.—The instrument consists of a vacuum photoelectric cell feeding into a valve voltmeter with logarithmic input characteristic. The voltmeter employs a type 6D6 valve which is provided with a properly chosen biasing resistor in the kathode lead. This gives a plate current proportional to the logarithm of the input voltage. Since this relationship never extends to zero plate current, a portion of the plate current is balanced out, giving, in effect, a suppressed zero instrument. Suitable shunts and a choice of input resistors afford several ranges of sensitivity. The output meter can be calibrated directly in concentration units. Other methods of achieving the same result are discussed. AUTHORS.

***4543. Trichromatic Colorimeter. R. Donaldson.** *Phys. Soc., Proc.* 47. *pp.* 1068–1073, *Nov.* 1, 1935.—A trichromatic colorimeter is described in which the integrating properties of a diffusing sphere are employed to effect the mixture of the three instrumental stimuli. Means are explained for obtaining linearity of the scales. The general construction is planned to keep the design as simple as is consistent with efficiency. AUTHOR.

4544. Colour-Matching of Tungsten-Filament Lamps by Means of a Single Photo-Cell and Colour Filters. J. S. Preston. *Phys. Soc., Proc.* 47. *pp.* 1012–1018, *Nov.* 1, 1935.—A method for colour-matching tungsten light sources is described, in which one photo-cell and two coloured filters are employed. The ratio of the total transmissions of the two filters, as measured by the photo-cell, is used as an empirical measure of the colour temperature of the source, a tungsten-filament lamp. For certain lamps and photo-cell filter systems the relation between this ratio and the lamp-voltage is approximately linear. An example of the use of the method in checking the calibration of standards of colour temperature is described, reference being made to a set of N.P.L. colour standards.

AUTHOR.

4545. Colour Temperatures of the Hefner and Acetylene Flames. A. R. Pearson and B. Pleasance. *Phys. Soc., Proc.* 47. *pp.* 1032–1041, *Nov.* 1, 1935.—The colour of the " cylindrical " acetylene flame depends on 3 factors, namely the gas-pressure, the rate of consumption and the height of the flame. Discordant statements in the literature are believed to be due to lack of uniformity in these particulars. The flame specified by Jones of the Kodak laboratory is 50 mm. high and consumes 0·25 ft.^{3}/hr. at 90 mm. (water) pressure. A 1-cm. section of a flame conforming closely to this specification, burning on a Bray Vika tip, is found to have colour temperature 2520° K. The flame on a Bray Ota tip at 90 mm. pressure is 58–60 mm. high and consumes 0·29–0·30 ft.^{3}/hr. One-cm. sections of two such flames were found to have colour temperatures (in round figures) 2380° and 2400° K. A large enough number of burners has not been tested to give the limits of variation to be expected, but if the three particulars mentioned above are closely adhered to, either flame is probably reproducible within a maximum range of ± 20° from the mean. The colour temperature of the Hefner flame is found to be 1910° K.

AUTHORS.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

4546. Magneto-Optics. C. G. Darwin. *Roy. Soc., Proc.* 151*A*. *pp.* 512–539, *Oct.* 1, 1935.—A "refractive tensor" is introduced and studied. The effective static magnetic field for the purposes of optics is discussed, and the refractive tensor for various models of matter is calculated and tested. Formulæ are given for the refractive effects of a general magnetised substance containing both free and bound electrons. The changes introduced by quantum theory are described, and it is shown that subject to certain conditions the formulæ lead to a general relation that should hold between the components of the refractive tensor. This relation is applied to the Kerr effect. If the test is fulfilled by the very uncertain experimental values, which is not improbable, the effective magnetic field in a ferromagnetic may be deduced. At saturation it is of the order of 3 to 15 million gauss, but is in every case directed in the opposite way from the molecular field of Weiss. [See also Abstract 3712 (1934).] C. B. A.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

4547. Induced Chemiluminescence of Mercury in the CO-O_2 Flame. V. Kondratjew. *Acta Physicochimica*, 2. 1. *pp.* 126–128, 1935. *In English.*—According to Bone, Newitt and Townend (*Gaseous Combustion at High Pressures*, 1929), the activation of N_2 followed by the formation of NO in the high-pressure explosion of CO–O_2–N_2 mixtures is due to radiation from the main CO explosion. The implied conclusion that N_2 molecules can absorb this radiation is at variance with recent data on the absorptive power of nitrogen. The mechanism of the N_2 activation must therefore be found in the collisions of N_2 molecules with the energy-rich (probably excited CO_2) molecules, appearing in the reaction zone during the combustion of CO. This view is supported by spectrograms of the flame of a CO–CO_2 mixture burning in the presence of mercury vapour. T. H. P.

4548. Active Nitrogen of Long Duration, Law of Decay and of Increased Brightness on Compression. (Lord) Rayleigh. *Roy. Soc., Proc.* 151*A*. *pp.* 567–584, *Oct.* 1, 1935.—Photometric study of the decay of active-nitrogen glow shows that catalytic activity of vessel walls is (*a*) considerable if they are coated with Apiezon oil, (*b*) very small with sulphuric acid, (*c*) minimum with metaphosphoric acid, the glow being visible for 6 hr. in a large bulb with (*c*). The rates of decay in cases (*a*) and (*c*) are roughly equal in early stages, but become more and more unequal later. In (*a*) the decay is exponential and apparently a first-order reaction. In (*c*) a second-order reaction is indicated, though third order is not excluded. Photometric study of the brightening under compression shows that intrinsic brightness is as $(\text{volume})^{-2}$ or as $(\text{concentration})^2$ of active material. This indicates a bi-molecular reaction in which excess of N_2 molecules has no part. Non-intervention of neutral molecules also agrees with the observation that, at constant volume, the time for decay between two standard intensities is almost independent of pressure at low pressures. At higher pressures this is no longer true and a secondary cause for action of excess of neutral gas, comparable perhaps with wall action, must be sought. W. J.

4549. Diabatic Reactions and Primary Chemiluminescence. R. A. Ogg, Jr., and M. Polanyi. *Faraday Soc., Trans.* 31. *pp.* 1375–1384, *Oct.*, 1935.—An outline of the theory of ionogenic reactions and a list of its applications is given with special reference to the theorem connecting reaction heat and reaction velocity. It is shown how this work is related to previous considerations of diabatic reactions. The primary chemiluminescence is described as an inverse process of predissociation involving diabatic chemical reactions immediately followed by the emission of light. AUTHORS.

See also Abstracts 4615, 4616.

INTERFERENCE. DIFFRACTION AND SCATTERING.

4550. Diffraction of a Harmonic Wave by a Semi-Infinite Screen. L. Cagniard. *J. de Physique et le Radium*, 7. *pp.* 369–372, *Sept.*, 1935.—A special case of the general theory of diffraction given in an earlier paper [see Abstract 3840 (1935)] is considered, viz. the effect of a kinematic discontinuity in a diffracted wave front and the problem is reduced to a static one. Simple solutions are obtainable by the author's method, and it is shown that for small wave-lengths the formulæ reduce to those given by Fresnel. J. E. R. C.

4551. Use of Lummer Plate with Polarised Light. J. H. Gisolf. *K. Akad. Amsterdam, Proc.* 38. 7. *pp.* 735–736, 1935.—A study is made of the influence of the polarisation of light on the sharpness of the interference fringes given by a Lummer plate. It is found that the resolving power is dependent upon the direction of the electric vector relative to the plate, and that the plate should be used in light with the electric vector parallel to the plate. A. H.

See also Abstracts 4444, 4466, 4626.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

4552. Photolysis of Dry Ozone. Part II. L. J. Heidt. *Am. Chem. Soc., J.* 57. *pp.* 1710–1716, *Sept.*, 1935.—Initially pure dry O_3 at 177 and 390 mm. was photolysed at $\lambda\lambda$ 208, 254 and 313 $m\mu$ to complete decomposition. Quantum yields, referred to O_3 molecules decomposed per quantum absorbed, were approximately equivalent at 208 and 313 $m\mu$. The ten-degree temperature coefficient for the photolysis was $1 \cdot 15 \pm 0 \cdot 02$ over the range 0° to 60°, this coefficient being apparently independent of the mole fraction of O_3 in O_2 and of the temperature interval. For small mole fractions of O_3 in O_2 the ten-degree temperature coefficient for the dark rate over the range 20°–60° was found to be $3 \pm 0 \cdot 1$. [For Part I see Abstract 680 (1935).] R. C. F.

4553. Photodissociation of Single Crystals of Nitrates in Polarised Light. L. K. Narayanswamy. *Faraday Soc., Trans.* 31. *pp.* 1411–1412, *Oct.*, 1935.—An account of an experimental study of the photodissociation of solid nitrates, particularly of single crystals, in connection with the work of Krishnan and Guha [see Abstract 314 (1935)]. C. B. A.

4554. Optical Dissociation of Stannous Chloride Vapour in the Schumann Region. H. Neujmin. *Acta Physicochimica*, 2. 5. *pp.* 595–602, 1935. *In German.*—The emission band spectrum of $SnCl_2$ vapour subjected to ultra-violet light in the region 1500–1600 Å is described. Analysis of the emission shows that, in this region, the action of light dissociates the $SnCl_2$ molecule into $SnCl + Cl$. The energy corresponding with the fission of one Cl atom from the $SnCl_2$ molecule is determined as about 90 cal./mol. T. H. P.

See also Abstract 4555.

PHOTOMETRY.

***4555. Apparatus for Darkfield Photometry and Densitometry. P. S. Williams and G. H. Scott.** *J.O.S.A.* 25. *pp.* 347–349, *Oct.*, 1935.—A simple densitometer for measuring the blackness of spectral lines is described. The instrument can also be used as a darkfield photometer for measuring the light scattered from ash deposits, etc. The essential feature of the instrument is a permanently mounted micro-projection system, the images from which are focussed on one or other of two interchangeable photo-cell boxes; one of these latter is used for densitometry, the other for darkfield photometry. A. H.

4556. Method of Photographic Spectrophotometry. E. W. Müller. *Zeits. f. Physik*, 97. 1–2. *pp.* 97–106, *Sept.* 23, 1935.—The method is suitable for measurements of the intensity of a spectral line under different conditions of excitation. A " wedge spectrum " is first obtained: it is produced by means of a shutter placed between the prism and the focal plane of the spectrograph. The shutter lies with its lower boundary on the optical axis of the spectrograph and the object glass is provided with a rectangular diaphragm. The plate is then displaced slightly in the direction of dispersion and a comparison spectrum, from a similar source run under standard conditions, is superimposed. The point where the blackening of the " wedge " line is equal to that of the standard line is found visually. A high precision is claimed. The application of the method to measurements of filter transmissions, and the use of the method in conjunction with a continuous spectrum for heterochromatic photometry, are described. D. H. F.

See also Abstracts 4514, 4541, 4542, 4544, 4545, 4560.

POLARISATION.

4557. Convergence Error in Depolarisation Measurements. R. Ananthakrishnan. *Indian Acad. Sci., Proc.* 2*A. pp.* 133–142, *Aug.*, 1935.—Scattering of light in an interference field is discussed and it is shown that for the case of two parallel plane-polarised intersecting beams the depolarisation at the interference maxima gives the correct value but at the interference minima the depolarisation ratio is reversed. The average depolarisation over the whole field is higher than the correct value. Cases are also considered where the lens, used to concentrate the light on the scattering medium, has a square or circular aperture. Some of the consequences are discussed and experimental results are given illustrating the points raised. [See following Abstract.] A. H.

4558. Depolarisation of Light Scattering in Gases and Vapours. R. Ananthakrishnan. *Indian Acad. Sci., Proc.* 2*A. pp.* 153–160, *Aug.*, 1935.—In view of the error in earlier work due to lack of parallelism of the light beams employed, which has already been discussed [see preceding Abstract], a redetermination has been made for a dozen gases and vapours. In all the cases examined the depolarisation is found to be much lower than had previously been thought. A. H.

4559. Origin of Optical Rotatory Power. T. M. Lowry. *Nature*, 136. *pp.* 191–192, *Aug.* 3, 1935.—An account is given of the development, from Born's theory of coupled vibrators (1915), of recent theories of the origin of optical rotatory power. The simplified theories of Kuhn and of Boys are described and criticised, and the importance of Born's general theory [see Abstract 2523 (1935)] is stressed. This has been applied with encouraging results to the prediction of the rotatory power of diaminospiroheptane (resolved by Pope and Jansen) in which spacial dissymmetry, and not the anisotropy of any particular radical, is the principal factor; but the chief importance of Born's results lies in their suitability for predicting the relative magnitudes of the rotatory powers of related compounds. T. M. L.

See also Abstracts 4551, 4605.

RADIATION, EMISSION.

4560. Ultra-Violet Radiation Measurement by Light Counter Tube Method. I. L. Roich. *Phys. Zeits. d. Sowjetunion*, 8. 2. *pp.* 223–226, 1935. *In German.*—Using the platinum-hydrogen light counter, tests were made of the validity of Planck's radiation law for the radiation in the ultra-violet emitted by a platinum oven black body. Light of a given wave-length isolated by means of a monochromator was focused on the light counter and the impulses liberated in the counter by the incident photons were amplified and mechanically counted, for different temperatures of the oven, determined thermoelectrically. The variation of light intensity with temperature obtained in this way agreed with Planck's law. The spectral response curve of the counter in the ultra-violet (2640 to 3260 Å) was also determined by observations at constant oven temperature and assuming Planck's law. W. S. S.

4561. Radiation and Absorption of Energy by Tungsten Filaments at Low Temperatures. I. Langmuir and J. B. Taylor. *J.O.S.A.* 25. *pp.* 321–325, *Oct.*, 1935.—The radiation of energy from a thoriated tungsten filament and the absorption of the energy radiated from the surrounding bulb have been measured by a method which eliminates difficulties arising from cooling effects of the leads. For a filament at a uniform temperature T_F in a bulb at temperature T_B the net radiation W in watts cm.$^{-2}$ is the difference between the outgoing radiation W_R and the absorbed radiation W_A. For values of T_F from 225° to 580° K. and of T_B from 77° to 473° K., $\log W_R = 83{\cdot}7105 - 100 + 5{\cdot}332 \log T_F$; $\log W_A = 83{\cdot}7105 - 100 + 4{\cdot}462 \log T_B + 0{\cdot}87 \log T_F$. The resistivity R_0 in this same range is given by $\log R_0 = 91{\cdot}7123 - 100 + 1{\cdot}23 \log T_F$. The characteristics, current, voltage, resistance and energy radiated as functions of temperature are tabulated. AUTHORS.

4562. Absorption of Decimetre Waves in Ionised Gases and Detection of Long-Wave Absorption by Excitation of H Atoms. T. Haase. *Zeits. f. Physik*, 23. 7. *pp.* 657–676, *Sept.*, 1935.—The production of electromagnetic waves and the measurement of wave-length over the range 7–30 cm. is discussed, and the absorption of these waves in H_2, N_2 and CO_2 was measured when a glow-discharge was taking place. The number of electrons in the glow discharge was estimated by Langmuir's method. From the intensity of the H*a* radiation the number of excited atoms was found. This number is so small that it is not possible to attribute the absorption of decimetre waves to the excitation of H atoms. G. E. B.

4563. Structure of the Ionosphere and Propagation of Short Waves. T. V. Ionescu and C. Mihul. *J. de Physique et le Radium,* 7. *pp.* 388–396, *Sept.,* 1935.—In order to explain the phenomena of the propagation of short waves the following hypotheses are proposed regarding the constitution of the ionised gases of the upper atmosphere : (*a*) there is no thermal equilibrium between the electrons and the molecules of gas ; (*b*) the interval of time between two successive impacts of an electron with gas molecules, in a given region of the ionosphere, is the same for all electrons ; (*c*) this interval of time, which increases progressively with the altitude, is of the same order of magnitude as the period of the wave ; (*d*) there is only a single layer of ionised gas whose electronic density varies with the altitude in a continuous manner without exhibiting many maxima and minima. By means of these hypotheses it has been found possible to deduce results concerning the reflection of short waves at normal and at oblique incidence which are in close agreement with experimental observations. An explanation is also furnished of such effects as long duration echoes, zones of silence, the propagation of short waves to great distances and the effect of the earth's magnetic field on short-wave propagation.

A. W.

4564. Modulation-Frequency-Change Technique for Ionospheric Measurements. G. Builder and A. L. Green. *Phys. Soc., Proc.* 47. *pp.* 1085–1097, *Nov.* 1, 1935.—The paper is a critical examination of Appleton's suggestion that the carrier-frequency-change technique should be modified by varying the frequency of modulation instead of the carrier frequency. Definite conclusions, which are set out in the paper, have been reached.

AUTHORS.

4565. Influence of a Magnetic Field on the H.F. Conductivity of an Ionised Medium. E. V. Appleton and D. B. Boohariwalla. *Phys. Soc., Proc.* 47. *pp.* 1074–1084, *Nov.* 1, 1935.—The relation between the transverse h.f. conductivity and the pressure of ionised air under the influence of an imposed magnetic field has been studied experimentally. The pressure at which such conductivity is a maximum is found to vary with the intensity of the magnetic field as is to be expected on theoretical grounds if the h.f. conductivity is due solely to electrons. The significance of the results in connection with ionospheric conductivity is discussed.

AUTHORS.

***4566. Receiver Discriminating between Right- and Left-Hand Circularly Polarised Wireless Waves. O. O. Pulley.** *Phys. Soc., Proc.* 47. *pp.* 1098–1116, *Nov.* 1, 1935.—A brief review of the history of magneto-ionic effects in the ionosphere, and the apparatus developed for their investigation is given. Because of the inflexibility of present methods of determining the polarisation of received waves, a new scheme has been developed which permits observations to be made over a range of frequencies without readjustment. The principle employed is that of an effectively rotating loop, the rotation being simulated by the modulation in phase quadrature of two loops at right angles. The theory of operation, the errors and the method of adjustment are investigated. Adjustment can be made with the aid of a test wave of unknown polarisation. Some results obtained with the apparatus are discussed, and it is concluded that the two magneto-ionic components are almost circularly polarised, and that the relative intensities are unpredictable unless the complete (P', f) curve appropriate to the time of observation is available. A Fourier-series treatment of the propagation of a pulse of energy of radio frequency in the ionosphere is given in an Appendix. AUTHOR.

4567. Conservation of Direction in the Impact of High-Energy Particles. W. F. G. Swann. *Frank. Inst., J.* 220. *pp.* 373–376, *Sept.*, 1935.—The purpose of this note is to show that particles which are projected forwards by the impact of another particle or of a photon will, if the rest masses of the particles concerned are small compared with their actual masses, travel in directions approximately parallel to the direction of motion of the incident photon or particle. The range of possible directions is worked out for a few cases to show how nearly the rule applies, *e.g.*, if the particles all have energies $> 10^9$ eV the directions will all lie within 0·2° of the direction of incidence. The bearing of these results upon cosmic ray phenomena is briefly discussed. J. E. R. C.

4568. Composition of Cosmic Rays. A. H. Compton. *Am. Phil. Soc., Proc.* 75. 4. *pp.* 251–274, 1935.—This paper covers the same ground, but with less detail, as does another paper by the same author [see Abstract 3859 (1935)]. A brief discussion is added in which it is shown that the author's conclusions are consistent with the magnitude of the diurnal variation. D. H. F.

4569. Secondary Effects of Cosmic Rays. H. Geiger. *Ergeb. d. exakt. Naturwiss*, 14. *pp.* 42–78, 1935.—Summary of work on the secondary effects of cosmic rays with special reference to : (1) detection of secondary rays with the tube counter ; (2) separation of the cosmic ray groups ; (3) interpretation of Rossi's coincidence curve ; (4) absorption of high energy photons and electrons ; (5) secondary rays below thick layers of matter ; (6) frequency of shower production at high altitudes ; (7) angular distribution of secondary radiations ; (8) stopping powers of different materials for the cosmic ray groups ; (9) peculiarities of the coincidence curve for great thicknesses of lead ; (10) recoil radiations from the floor and sides of the shield ; (11) ionisation processes by corpuscular cosmic rays ; (12) ray statistics and energy distributions with the Wilson chamber. A Bibliography of 78 papers is appended. F. C. C.

***4570. Construction of Light Sources and Furnaces of the Nernst Type. C. Tingwaldt.** *Phys. Zeits.* 36. *pp.* 627–629, *Oct.* 1, 1935. *From the Reichsanstalt.*—A new installation is described in which yttrium and zirconium oxides are used in the construction of Nernst filaments. The pure oxides are used and thus temperatures up to 2000° C. are obtained. The constructional details are given, the lamp being of tubular form and the oxide filaments being also cylindrical. Experimental facts and tables are included. S. G. B.

See also Abstract 4697.

RADIATION. MECHANICAL EFFECTS.

4571. Separation of Light-Pressure and Radiometer Forces. H. Castelliz. *Zeits. f. Physik*, 96. 9–10. *pp.* 677–685, *Sept.* 12, 1935.—The apparatus consists essentially of a torsion arm mounted in a vacuum on a fine suspension, and carrying a thin plate at 45° to the arm. The incident light can be made to fall on the plate in two directions at right angles. When the light beam is parallel to the arm, the light pressure exerts no turning moment, so that the true and radiometer effects may be distinguished. The pressure p was found to be $1 \cdot 77 \times 10^{-5}$ dyne, and the radiation energy $E = 5 \cdot 1 \times 10^5$ ergs./sec., so that $pc/E = 1 \cdot 04$ (c=velocity of light). Thus the theoretical conclusion that $p = E/c$ was verified. G. E. B.

See also Abstract 4499.

REFLECTION. REFRACTION AND DISPERSION.

***4572. Simplified Computation of Cartesian Lens Surfaces. L. Silberstein.** *J.O.S.A.* **25.** *pp.* **340–341,** *Oct.*, **1935.**—A simplified method of computation is given, the simplifying artifice being the comparison of the quartic curve with its curvature circle at the axial point $x = 0$ and, ultimately, evaluating the difference of the abscissæ of the curve and the circle corresponding to the same ordinate y, say $\Delta x = x - x_0$, where x_0 is the abscissa of a point on the circle. A. H.

4573. Spherical Aberration. T. Malinowski. *Rev. d'Optique,* 14. *pp.* 265–292, *Aug.*, 1935.—Discusses the criteria for spherical aberration basing the discussion on small aperture objectives of the Clairaut type. Large aperture (microscope) objectives are then dealt with on the basis of the results already obtained. A. H.

4574. Accuracy of Microscopical Methods for Determining Refractive Index by Immersion. C. F. Saylor. *Bureau of Standards, J. of Research,* **15.** *pp.* **277–294,** *Sept.*, **1935.**—The accuracy of immersion methods used in petrography for determining refractive indices is limited by the sensitivity of the criterion of match. A study is made of the sensitivity of various well-known methods of ascertaining match, as a function of objective aperture and size and shape of particle. It is found, *e.g.*, that a single determination of the refractive index of potassium alum may have a probable error varying from 0·00008 to 0·00104, depending upon the conditions employed. It is found that all methods are more sensitive with objectives of low numerical aperture. An examination is also made of the errors introduced by birefringence. A. H.

See also Abstracts 4496, 4497, 4498.

SPECTROSCOPY.

4575. Excitation in He by Impact of He Atoms at 0 to 6000 V. W. Maurer. *Zeits. f. Physik,* 96. 7–8. *pp.* 489–502, 1935.—The excitation function of 13 lines between 5016 and 3613 Å was observed, due to the impact of He atoms of 300 to 6000 V. There is great similarity to excitation by electrons of 0 to 40 V as regards strong triplet excitation, enhancement of the principal singlet system and similar behaviour of the first associated series of both singlets and doublets. F. S.

4576. Absorption Spectrum of Eu^{+++} in Crystalline $Eu_2(SO_4)_3 \cdot 8H_2O$. E. J. Meehan. *J. Chem. Phys.* 3. *pp.* 621–626, *Oct.*, 1935.—The absorption spectrum of $Eu_2(SO_4)_3 \cdot 8H_2O$ has been studied over the temperature range 14° K.–290°K. Measurements of the absorption lines are given for five temperatures. Intensity variations caused by a change in temperature have been used to establish definitely the existence of levels 21 cm.$^{-1}$ and 41 cm.$^{-1}$ above the basic one, and to indicate the existence of 67 cm.$^{-1}$, 86 cm.$^{-1}$, and possible higher levels. An unusual feature of the spectrum is the constant energy difference occurring between many lines which are most intense at the lowest temperatures. AUTHOR.

4577. Analysis of Zn IV Spectrum. T. S. Subbaraya. *Indian Acad. Sci., Proc.* **2A.** *pp.* **113–118,** *Aug.*, **1935.**—Hutchinson's values of wave-lengths were used, but, owing to discrepancies with those of Laporte and Lang, recurring differences were not relied on in the classification. Intensity and completeness of the multiplets is a surer indication, and also the fact that almost all lines in a certain region belong to a certain stage of ionisation. For Zn IV this region is from λ1443 to λ1030. Tables of wave-lengths and term values are given as well as comparison with spectra of Co I, Ni II and Cu III. F. S.

4578. Displacement of the Higher Caesium Terms by Saturated Hydrocarbons and Measurements on the 1s-3p Doublet of the Principal Series of Potassium. C. Füchtbauer and H. J. Reimers. *Zeits. f. Physik*, 97. 1–2. *pp.* 1–7, *Sept.* 23, 1935.—Saturated hydrocarbons, methane, ethane and propane show marked red displacement of the Cs lines, 1*s*–7*p* and 1*s*–30*p* and the displacement increases with the molecular weight of the hydrocarbon. The influence of He, Ne, A, N_2, H_2, CH_4, C_2H_6 and C_3H_8 on the 1*s*–3*p* doublet of K is discussed. W. R. A.

4579. New Terms in the Spectrum of Fe II. J. C. Dobbie. *Roy. Soc., Proc.* 151*A*. *pp.* 703–726, *Oct.* 1, 1935.—Over 900 lines in the spectrum of Fe II are accounted for by the proposed terms, bringing the total number of classified lines in the spectrum to about 1250. Tables are given showing the possible terms and the allocations which have been made. It is concluded that the Fe II spectrum is an illustration of fairly close approximation to Russell-Saunders coupling. [See also Abstract 4155 (1935).] A. H.

4580. Iridium Isotopes and Their Nuclear Spins. B. Venkatesachar and L. Sibaiya. *Indian Acad. Sci., Proc.* 2*A*. *pp.* 203–207, *Aug.*, 1935.—The hyperfine structure patterns of some of the significant arc lines of Ir have been photographed using as source a hollow kathode tube already described [see Abstract 3870 (1935)]. An examination of the hyperfine structure data of the Ir lines leads to the result that it consists of two isotopes with nuclear spins $\frac{1}{2}\frac{h}{2\pi}$ and $0\frac{h}{2\pi}$. A consideration of known facts regarding the occurrence of isotopes of different mass numbers in the various elements has led to the inference that the mass numbers of the two Ir isotopes are 191 and 193 with a relative abundance of nearly 1 : 2, the isotope with the higher mass number having the higher nuclear spin. AUTHORS.

4581. Calculation of Atomic Energy Levels. T. Yamanouchi. *Phys. Math. Soc. Japan, Proc.* 17. *pp.* 274–288, *July*, 1935. *In English.*—Slater's method of calculating the energy levels of an atom for LS-coupling is simplified by use of the theory of group representations and simple formulæ are derived for the energy levels of each multiplet system. The application of the formulæ to the d^3 configuration, in which there are two ^2D states, is worked out by way of example. J. E. K.

4582. Absorption Spectra of Simple Substituted Hydrocarbons in the Near Infra-Red. Part I. Influence of State of Aggregation. R. Mecke and O. Vierling. *Zeits. f. Physik*, 96. 9–10. *pp.* 559–570, *Sept.* 12, 1935.—The absorption spectra of gaseous and liquid CH_3Cl, CH_3Br, C_2H_5Cl, C_2H_3Cl and C_2H_4O are investigated in the region of the third CH– overtone. In addition to changes in the absorption curves, a decrease in frequency is also observed on condensation, and this is attributed to the attractive forces exerted by neighbouring molecules. The effect of ring closure is investigated by measurements with C_6H_{14}, C_6H_{12},

$C_6H_{11}OH$, C_6H_6 and $C_4H_8O_2$. Decreases in frequency on ring formation are observed. C. B. A.

4583. Photographic Infra-Red Spectrum of Methylacetylene and the Nuclear Distance of the Simple C—C Binding. G. Herzberg, F. Patat and H. Verleger. *Phys. Zeits.* 36. *p.* 625, *Sept.* 15, 1935.—The absorption spectrum of methylacetylene is photographed in the near infra-red with the experimental arrangement previously described [see Abstract 3727 (1935)]. An intense absorption band is found at 1·03 μ and, like the C_2H_2 band lying in the same position, is interpreted as the second harmonic of the C—H vibration. The fine structure of the band is analysed and found to be in accordance with the assumption that the methylacetylene molecule is a symmetrical top with the $-C\equiv C-H$ group as axis. The moment of inertia about an axis perpendicular to the axis of the top is calculated as 97·59 gm.cm². Assuming the $\equiv C-H$ and $-C-C$ distances to be the same as in acetylene and the C—H distance and valency angle in the CH_3 group to be as in methane the nuclear distance of the $\equiv C-C\equiv$ group is calculated to be 1·525 ± 0·005 Å. It is considered probable that the simple C—C binding has the same separation in other molecules. J. E. K.

4584. Structure and Interpretation of Infra-Red Absorption Spectra of Crystals. R. B. Barnes, R. R. Brattain and F. Seitz. *Phys. Rev.* 48. *pp.* 582–601, *Oct.* 1, 1935.—An experimental and theoretical investigation of the absorption spectrum of MgO in the near infra-red is reported. Part A is devoted to the experimental results, which were obtained by use of a rock-salt spectrometer. They show that the fundamental absorption is accompanied by a great deal of secondary structure. In Part B an interpretation of the results of A is undertaken on the basis of a quantum-mechanical treatment of anharmonic potential forces. On this basis, it is shown that a cubic crystal of the MgO type should not possess but a single near infra-red absorption as previous calculations had indicated, but should possess an extremely complicated secondary structure. In Part C the possibilities of obtaining a quantitative correlation between experiment and theory are discussed and it is concluded that the former must be made the object of additional refinements. AUTHORS.

4585. Absorption Spectra of Free Radicals. L. C. Anderson. *Am. Chem. Soc., J.* 57. *pp.* 1673–1676, *Sept.*, 1935.—Curves are presented for the quantitative absorption spectrum of ether solutions of triphenylmethyl and of the sodium derivative of triphenylmethyl, and SO_2 solutions of triphenylbromomethane and of triphenylmethyl. The data indicate that triphenylmethyl exists in a quinonoid modification in solution in ether and in SO_2. When dissolved in SO_2 triphenylmethyl is in equilibrium with the triphenylmethyl kation and an electron, with solvation, of course, of the ions. AUTHOR.

4586. U.V. Absorption Spectra of Gaseous, Dissolved and Liquefied Ammonia. A. Briot and B. Vodar. *Comptes Rendus,* 201. *pp.* 500–501, *Sept.* 9, 1935.—Previous u.v. observations were made with the gas at various temperatures and pressures [see Abstract 3028 (1933)]. 2 cm. thickness of the liquid has an absorption continuum extending to λ2320 at −78° C., to λ3400 at −33·5° and to λ2480 at 26°, *i.e.*, increasing with temperature. The solution has a continuum which increases with concentration (concentrations from 0·06 to 16 mol./l. were used) but is always smaller than the continuum of the pure liquid. The gas at 10 atmospheres, containing about 0·5 mol./l., is more absorptive than the solution of the same concentration. The bands of the gas are not appreciably displaced as temperature and pressure are varied, but a given number of molecules produce greater absorption at high pressures than at 1 atmosphere; thus the band near λ2250 is faint in 20 mm. thickness at 10 atmospheres, but distinct in 200 mm. at 1 atmosphere. The polymerisation hypothesis which explains infra-red displacements [see Abstract 2109 (1935)], probably account for the temperature effects described here. W. J.

4587. Absorption Spectra of Iodine Solutions and Influence of Solvent. O. J. Walker. *Faraday Soc., Trans.* 31. *pp.* 1432–1438, *Oct.*, 1935.—Measurements have been made of the molecular extinction coefficient, ϵ, between 440 and 600 mμ for violet solutions of I_2 in the following solvents: (1) CCl_4, (2) $CHCl_3$, (3) CH_2Cl_2, (4) $C_2H_4Cl_2$, (5) *n*-C_3H_7Cl, (6) *n*-C_4H_9Cl, (7) *cis*- and (8) *trans*-$C_2H_2Cl_2$. For solutions in the two non-polar solvents (1) and (8) λ_{max} is at 516–518 mμ. For solutions in the other solvents λ_{max} is displaced towards the u.v., the displacement increasing roughly with the dipole moment of the solvent. The height and width of the absorption band in solutions 1-6 are approximately constant. The various types of interaction between I_2 and solvent are discussed with regard to their influence on the absorption spectrum of I_2. AUTHOR.

4588. Absorption of Light by Porphyrins. Part II. A. Stern and H. Wenderlein. *Zeits. f. phys. Chem.* 174. *Abt. A.* 2. *pp.* 81–103, 1935.—The absorption spectra of further porphyrins, in dioxan solution, are investigated, and the influence of substituents on their band maxima, and also on those of the dihydroporphyrins, is discussed. As a special case of isomerism, the spectra of several porphyrins are compared with those of the corresponding chlorins. The change in structure attributed to the latter on chemical grounds is confirmed. Chlorins, pyrophäophorbid *a*, and methylphäophorbid *a* have very similar spectra in the visible. The spectra of uroporphyrins petry and pteria, and of 1, 3, 5, 7-tetramethylporphyrin-2, 4, 6, 8-tetra-succinic-octamethyl ester are identical. The spectrum of pure haemin in dioxan is also recorded. [For Part I see Abstract 5045 (1934).] C. B. A.

4589. Ultra-Violet Absorption of Ketones. T. M. Lowry and R. E. Lishmund. *Chem. Soc., J. pp.* 1313–1319, *Sept.*, 1935.—Quantitative measurements of the absorption bands of a series of ketones have shown that bands which are symmetrical on a scale of wave-lengths are given by three alicyclic ketones, two hydroxy-ketones, and two enolic diketones. Bands which are steeper on the side of longer wave-lengths are given by simple aliphatic ketones and their chloro-derivatives, as well as by camphor and piperitone. Bands symmetrical on a scale of frequencies, or steeper on the side of shorter wave-lengths, have not been observed. The ketonic absorption band is displaced towards the visible region when hydrogen is replaced by chlorine, but towards the further ultra-violet when it is replaced by hydroxyl. Cooling to the temperature of liquid air displaces the head of the band by about 50 Å towards the extreme ultra-violet region, but has no great effect on the intensity of the band. AUTHORS.

4590. β-Bands of Boron Monoxide. A. Elliott. *K. Akad. Amsterdam, Proc.* 38. 7. *pp.* 736–738, 1935.—In reply to the statement of Funke and Simons [see Abstract 1649 (1935)] that they had been unable to detect the spin doubling previously reported for the β bands of BO—details are given of the measurements and these latter are tabulated. A. H.

4591. Extreme U.V. Spectrum of Hydrogen Deuteride HD. Y. Fujioka and T. Wada. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 587. *pp.* 210–234, *Sept.*, 1935. *In English.*—The spectrum of a 500 V.d.-c. discharge through a tube containing 70 % H and 30 % D is photographed from λ1620 to λ1045 in the second order of a 1 m. concave grating at grazing incidence, dispersion being from 180 to 380 cm.$^{-1}$/mm. H_2 wave-lengths by Jeppesen [see Abstract 4517 (1933)] and the authors are used as standards. The HD lines in the composite spectrum of H_2, HD and D_2 are identified with the help of the calculated (vibrational + rotational) isotopic displacement $\nu_{HD} - \nu_{HH}$, the value of $\rho = (\mu_{HH}/\mu_{HD})^{\frac{1}{2}}$ being taken as 0·86617. The HD bands analysed are 13 of the system $2p\pi\,{}^1\Pi \rightarrow 1s\sigma\,{}^1\Sigma$ and 37 of the system $2p\sigma\,{}^1\Sigma \rightarrow 1s\sigma\,{}^1\Sigma$. These systems, corresponding to the Werner and Lyman of H_2, have been previously studied by Jeppesen and Mie [see Abstracts 2038 (1934) and 309 (1935)]. Observed and calculated $\nu\nu$ are tabulated, and from their differences the electronic isotope effects in the two excited states are obtained, that in the ground state $1s\sigma\,{}^1\Sigma$ being taken as zero. The height and electronic shift are 91718·9 and 10·9 cm.$^{-1}$ for $2\,p\sigma\,{}^1\Sigma$, and 100063·6 and 14·6 cm.$^{-1}$ for $2\,p\pi\,{}^1\Pi$. W. J.

4592. Predissociation of C$^1\Sigma$ State of CO. R. Schmid and L. Gerö. *Zeits. f. Physik*, 96. 7–8. *pp.* 546–550, *Sept.* 7, 1935.—The lines of the Herzberg CO bands, $c^1\Sigma \rightarrow A^1\Pi$, developed to comparatively high rotational levels in a " Back box " [see Abstract 1650 (1935)], suddenly fall-off in intensity at the level $v' = 0$, $J' = 29$ of the $c^1\Sigma$ state ; no bands are observed with $v' > 0$. If this fall-off is attributed to a crossing of the $c^1\Sigma$ state by a predissociation limit, the latter is 1685·4 cm.$^{-1}$ above the lowest level of $c^1\Sigma$, *i.e.*, 93520 cm.$^{-1}$ above the lowest level of the ground state $x^1\Sigma$, and therefore 3900 cm.$^{-1}$ (= 0·48 V) above the predissociation limit already known from the Ångström bands. If this separation of the two predissociation limits is identified with the energy-difference of 0·54 V. between the possible dissociation products, namely C (^{1}D) + O (^{1}D) for the upper (new) and C (^{1}S) + O (^{3}P) for the lower (old), a dissociation energy of 8·40 V. is obtained for the ground state of CO. This value, which agrees closely with the 8·41 V. given by Coster and Brons [see Abstract. 2898 (1934)], receives some support from the extrapolated convergences of the $x^1\Sigma$, $A^1\Pi$ and $F^1\Pi$(?) states. W. J.

4593. Interpretation of Perturbations in N_2 Second Positive Bands. L. Gerö. *Zeits. f. Physik*, 96. 9–10. *pp.* 669–676, *Sept.* 12, 1935.—Coster, Brons and v. d. Ziel observed certain special perturbations in the N_2 second positive bands, $c^3\Pi_u \rightarrow B^3\Pi_g$. They attributed those in bands with $v' = 2$ and 3 to crossings of these levels of the $c^3\Pi$ state by $^3\Pi$ and $^3\Delta$ states respectively, but they did not discuss the perturbations in bands with $v' = 1$ and 4. The author investigates these by plotting B'–B'' against J [see Abstract 3882 (1935)], and shows that the two perturbing levels belong to one and the same $^3\Sigma^-$ state, and have $B_v = 1{\cdot}57$ and $1{\cdot}49$ respectively. The other perturbations of the $v' = 4$ levels of the $c^3\Pi$ state [see Abstract 1648 (1935)] are caused by the same state as the predissociation of $c^3\Pi$, namely a perturbing $^3\Pi_u$ state. An exact value of B_4, therefore, cannot be found for the $c^3\Pi$ state. W. J.

4594. NH Bands near λλ3360, 3370. G. W. Funke. *Zeits. f. Physik*, 96. 11–12. *pp.* 787–798, *Sept.* 18, 1935.—The NH bands with prominent intensity maxima at λλ3360 and 3370 are the 0, 0 and 1, 1 bands of a $^3\Pi \rightarrow {}^3\Sigma$ system, and the maxima represent superpositions of all the Q-branch lines owing to the closeness of the *B*-values for $^3\Pi$ and $^3\Sigma$. To analyse these bands more completely than hitherto, the author uses a high-power arc (400 V, 15 A) between watercooled tungsten electrodes in streaming NH_3 at fairly high pressures (about 100 cm. Hg). The bands are intense and free from the neighbouring N_2 band, λ3371. The nine strong branches (including the three resolved Q branches) of each band are photographed in dispersion 0·42 Å/mm., and two weaker branches in 1·68 Å/mm. Constants obtained are :—

	B_0	B_1	-10^3D_0	-10^3D_1	r_e	ω_e
$^3\Pi$	16·29	15·57	1·72	1·77	1·04 Å	c. 3300
$^3\Sigma$	16·33	15·69	1·67	1·65		c. 3300

Spin-trebling in $^3\Sigma$, and Λ-doublings in $^3\Pi_0$, $^3\Pi_1$, $^3\Pi_2$ are evaluated and plotted against *K*. Observed line-broadening is mostly Doppler effect. Traces of the Q branches occur in absorption by flames, showing that $^3\Sigma$ is the ground state. W. J.

4595. Green Flame of Phosphorus Hydride. E. B. Ludlam. *J. Chem. Phys.* 3. *pp.* 617–620, *Oct.*, 1935.—The rotational structure of the bands in the green flame of phosphorus indicates that the emitting molecule is PH. AUTHOR.

4596. Spectra of Strontium Hydride. W. R. Frederickson, M. E. Hogan, Jr., and W. W. Watson. *Phys. Rev.* 48. *pp.* 602–606, *Oct.* 1, 1935.—New SrH band systems photographed at high dispersion include : (1) an abbreviated $C^2\Sigma \rightarrow N^2\Sigma$ system with (0,0) band head at 3808 Å ; (2) a many-lined $D^2\Sigma \rightarrow N^2\Sigma$ system between 5000 Å and 6700 Å ; (3) an $E^2\Pi \rightarrow N^2\Sigma$ system consisting of a $\Delta v = 0$ sequence only with the (0,0) band at 5323 Å. The (0,0) and (0,1) C bands have three violent perturbations and a sharp cut-off due to predissociation at $K' = 19$. The form and magnitude of the perturbations are computed. Quantum analyses give $B_0 = 3 \cdot 930$ and $D_0 = -9 \cdot 31 \times 10^{-4}$ for the C state, $B_1 = 3 \cdot 56$ for the normal state. Quantum assignments of the lines of the six principal branches of the (0,0) band of the E system are presented. For the E state $A = 117$, $B^*_{0, -\frac{1}{2}} = 3 \cdot 6388$, $B^*_{0, +\frac{1}{2}} = 3 \cdot 8687$ and perturbations at small J values distort the Λ-doubling curve for the $^2\Pi_{\frac{1}{2}}$ state. AUTHORS.

4597. Analytical Construction of the Potentials of Diatomic Molecules and their Estimation from Spectroscopic Data. Part I. General Theory. Part II. Application to the Molecules CdH and N_2. E. A. Hylleraas. *Zeits. f. Physik*, 96. 9–10. *pp.* 643–668, *Sept.* 12, 1935. *Phys. Zeits.* 36. *pp.* 599–600, *Sept.* 15, 1935.

4598. Characteristic Vibrations of Heavy Acetylene and of Ethylene Halides. Y. Morino and S. Mizushima. *Phys. Zeits.* 36. *pp.* 600–602, *Sept.* 15, 1935.—The fundamental vibrations of heavy acetylene are calculated and certain molecular constants. Similar calculations are performed for ethylene chloride and bromide. W. R. A.

4599. Spectra of van der Waals Molecules. W. Finkelnburg. *Zeits. f. Physik*, 96. 11–12. *pp.* 699–713 *and* 714–719, *Sept.* 18, 1935.—The properties of van der Waals molecules and general rules for the interpretation of their spectra are discussed, those points being stressed in which such molecules behave differently from molecules bound by valence forces. Various possibilities of interaction in excited van der Waals molecules are discussed, and some properties of the spectra to be expected on combination of the various potential curves are deduced. The application of the Franck-Condon principle to such molecules is considered and their resonance-fluorescence spectra and the question of excited van der Waals states in liquids are treated. In the second paper, these general results are applied to the particular case of the molecular spectra of Cd. C. B. A.

4600. $3p^3\Sigma \rightarrow 2s^3\Sigma$ Bands of HD and D_2. G. H. Dieke. *Phys. Rev.* 48. *pp.* 606–609, *Oct.* 1, 1935.—The $3p^3\Sigma \rightarrow 2s^3\Sigma$ bands of HD and D_2 which form the most conspicuous regularities in the near infra-red are given and the band constants calculated. [See Abstracts 1639 and 3037 (1935) and following Abstract.] AUTHORS.

4601. Triplet 3*p* Complex of the Hydrogen Molecule. G. H. Dieke. *Phys. Rev.* 48. *pp.* 610–614, *Oct.* 1, 1935.—Many peculiarities first observed in the Fulcher bands of the hydrogen molecule can be explained by the interaction of the $3p^3\Pi$ with the $3p^3\Sigma$ level. Such peculiarities are: irregular Λ-doublings, perturbations in the $3p^3\Pi$ and $3p^3\Sigma$ state, and the absence of P and R branches for large values of the vibrational quantum numbers. This last phenomenon is due to the predissociation of the $3p^3\Pi$ state. [See preceding Abstract.] AUTHOR.

4602. Continuous Absorption Spectrum of Hydrogen Bromide. C. F. Goodeve and A. W. C. Taylor. *Roy. Soc., Proc.* 152*A*. *pp.* 221–230, *Oct.* 15, 1935.—The extinction coefficients of HBr have been measured over a wide range of pressures and tube lengths. The approximate course of the upper potential energy curve has been calculated from the eigenfunction of the ground state and the observed extinctions. The results favour the dissociation into normal atoms, and indicate the difficulties of extrapolation of absorption thresholds in the determination of heats of dissociation. AUTHORS.

4603. Quenching of Cadmium Resonance Radiation by Foreign Gases. H. C. Lipson and A. C. G. Mitchell. *Phys. Rev.* 48. *pp.* 625–630, *Oct.* 1, 1935.—Measurements have been made on the quenching of the Cd resonance line 3261 by H_2, D_2, CO, NH_3, N_2 and CH_4. The experiment was carried out by comparing the intensity of 3261 emitted from a cell containing Cd vapour and foreign gas with that from a cell containing Cd vapour only. The cells were illuminated simultaneously and the results obtained by the method of photographic photometry. The experiments were performed under conditions (low vapour pressure, short light path through the vapour and small foreign gas pressure) which warrant the application of the Stern-Volmer formula. The quenching cross-sections obtained therefrom are: H_2, 0·67; D_2, 0·19; CO, 0·14; NH_3, 0·041; N_2, 0·021; CH_4, $0{\cdot}012 \times 10^{-16}$ cm². AUTHORS.

4604. Proportionality between Displacements and Field in the Zeeman Effect in Three Mercury Levels. G. Dupouy and P. Jacquinot. *Comptes Rendus*, 201. *pp.* 543–544, *Sept.* 30, 1935.—The Zeeman effect in the 4047, 4358 and 5461 lines of Hg ($^3S_1$–$^3P_{0.1.2}$) is investigated in fields between 30,000 and 50,000 gauss. For $^3P_1$, $\delta\nu/H$ is rigorously constant, but it is not constant for $^3S_1$ and $^3P_2$. In the sextuplet arising from 4358, the displacements of the components 2 and 5 are proportional to the field; those of 1 and 6 increase rather more rapidly. C. B. A.

4605. Polarisation of the Raman Lines of *p*-, *m*-, and *o*-Xylene. W. C. Narkiewicz. *Zeits. f. Physik*, 96. 3–4. *pp.* 177–190, *Aug.* 22, 1935. —The degree of polarisation of the separate Raman lines of *p*-, *m*- and *o*-xylene have been determined. Results for isomeric molecules are discussed. W. R. A.

4606. Raman Spectra of Substances with Two Benzene Rings. P. Donzelot and M. Chaix. *Comptes Rendus*, 201. *pp.* 501–503, *Sept.* 9, 1935.—The Raman spectra of diphenyl and substances $C_6H_5.X.C_6H_5$, where X = CH_2, O, S, Se, CHOH or Hg, are investigated in dispersion about 18 Å/mm., the exciting lines being Hg λλ4047, 4358. The substances that are solid at ordinary temperatures are used in the molten state, the observation tube being placed in a small electrically heated bath. The observed Raman frequencies for each substance are listed. The benzene Raman lines are observed almost undisplaced. The first three frequencies for $(C_2H_5)_2O$ (viz. 219, 248, 307), $(C_2H_5)_2S$ (viz. 187, 216, 270), and $(C_2H_5)_2Se$ (viz. 175, 201, 249) diminish with increasing molecular weight, and appear to be attributable to the atoms O, S, Se. The lines 187 and 216 are given by the sulphide either crystallised or dissolved in CS_2. The selenide gives a broad line at 318 which has no analogue in the other spectra. W. J.

4607. Raman Spectrum and Constitution of Fuming Sulphuric Acid. N. G. Pai. *Phil. Mag.* 20. *pp.* 616–623, *Oct.*, 1935.—The Raman spectra of fuming sulphuric acids of four different concentrations have been studied. The following are the main results obtained. At the earlier stages all the SO_3 molecules go into combination, forming $H_2S_2O_7$. The H_2SO_4 lines weaken correspondingly in intensity. In the higher concentration acids a considerable amount of free SO_3 molecules and of its dimer S_2O_6 are present. In the 71 % acid their relative proportions are nearly the same as in an ordinary SO_3–S_2O_6 mixture in equilibrium. Even in the 80 % acid, there is a small concentration of free H_2SO_4 molecules.

AUTHOR.

***4608. Glow Discharge Tube Cooled with Liquid Air. H. Schüler and T. Schmidt.** *Zeits. f. Physik*, 96. 7–8. *pp.* 485–488, *Sept.* 7, 1935.—A new simplified construction of hollow-kathode glow discharge tube is described, both the anode and kathode of which can be cooled with liquid air. When worked at 250 V and 60 mA to provide an intense source of light for hyperfine structure photography about 0·5 l. of liquid air is used per hour. Thin tissue paper smeared with Apiezon grease is found to be a suitable insulating material for use between kathode and anode at the low temperatures prevailing in the tube. With this tube it is found possible to photograph the hyperfine structure of the green line 5351 Å of Tl with only 10^{-6} gm. of Tl in the tube. J. E. K.

See also Abstracts 4439, 4529, 4553, 4554, 4629, 4655.

VISION.

4609. Determination of Visual Thresholds. J. P. Conner and R. E. Ganoung. *J.O.S.A.* 25. *pp.* 287–294, *Sept.*, 1935.—Gives the results of an investigation on the mutual relations among visual acuity, background luminosity and contrast, using luminosities ranging from 0·0001 to 1·0 lumen /ft.^{2}, the contrast range being 1·77 to 92·9 %. The relations between visual acuity and background illumination for foveal vision alone, and also for parafoveal vision, were determined. Curves of visual acuity against luminosity were found to be straight lines of small slope for parafoveal vision, and for foveal vision the curves were found to be straight lines descending sharply to zero as the luminosity was reduced.

The results obtained also show that the effect of rod vision for foveal vision is minimised by using red light. Specific information applying to the low values of illuminations in outdoor lighting can be obtained from the visual acuity curves for normal vision in light from incandescent lamps. Since foveal and parafoveal vision are governed by separate linear functions, separate considerations of these two functions might result in simpler and more exact methods of treating illumination problems. R. C. F.

X-RAYS.

4610. Diffuse Scattering of X-Rays by Conduction Electrons. C. Zener. *Phys. Rev.* 48. *pp.* 573–576, *Oct.* 1, 1935.—A theoretical expression is obtained for the scattering of X-rays from a completely degenerate free electron gas. Both the classical and the Compton methods are used. The modifications introduced by the periodic potential of the lattice are examined. The scattering by the conduction electrons is found to decrease with the first power of the scattering angle. It is shown that the diffuse scattering by the core electrons decreases as the second power of the angle of scattering. Hence the scattering by the conduction electrons will dominate all other diffuse scattering at sufficiently small angles. AUTHOR.

4611. Diffuse Scattering of X-Rays from Neon-Like Crystals. G. E. M. Jauncey and J. H. Deming. *Phys. Rev.* 48. *pp.* 577–581, *Oct.* 1, 1935.—Experiments are described which are designed to test the need for the extra negative term which arises, according to the Waller-Hartree theory, from the Pauli exclusion principle. The diffuse scattering of X-rays from NaF, MgO and SiC is measured, various precautions being taken. The experimental results show excellent agreement with the Waller-Hartree theory and thus give definite evidence for the operation of the Pauli exclusion principle on the outer shell electrons. J. T.

4612. Relation between Blackening and X-Ray Intensity for Characteristic Cu Radiation and Agfa-Laue Film. F. D. Miles. *Faraday Soc., Trans.* 31. *pp.* 1452–1460, *Oct.*, 1935.—The density of blackening of Agfa-Laue film by characteristic Cu radiation may be taken to be proportional to the X-ray intensity up to a density of 1·0. The error involved in this is at the most 4 % of the highest density measured. There is no evidence of threshold effect. AUTHOR.

4613. New Emission Lines in the Kα Spectra of the Elements Cu (29) to Rh (45). H. Hulubei. *Comptes Rendus*, 201. *pp.* 544–547, *Sept.* 30, 1935.—The group $K\alpha_{3,4}$ has been observed in the spectra of all elements between Cu and Rh inclusive. For Cu, Zn and As, it consists of a triplet; for the other elements up to Zr (40), of a doublet, but it appears that the structure is still more complex. The wave-lengths are tabulated and compared with the results of other workers. C. B. A.

4614. X-Ray Diffraction by Single Crystal Antikathode. W. Kossel and H. Voges. *Ann. d. Physik*, 23. 8. *pp.* 677–704, *Sept.*, 1935.—A comprehensive study is made of the X-ray diffraction effects observed when the antikathode itself serves as the diffracting crystal, being itself a single crystal. From geometrical and theoretical considerations an explanation of the positions and intensities of the observed reflections is given. J. T.

4615. Fluorescence X-Radiation and Electron Diffraction by Single Crystals. M. v. Laue. *Ann. d. Physik,* 23. 8. *pp.* 705–746, *Sept.,* 1935.—A detailed (mathematical) investigation shows that the optical reciprocity law in conjunction with the dynamic theory of X-ray interference leads to an interpretation of experiments on the privileged emission directions in a single crystal. In the case of electron waves, the Kikuchi lines provide an analogue. C. B. A.

4616. X-Ray Luminescence of Organo-Metallic Compounds. Edith Weyde. *Zeits. f. wiss. phot.* 34. *pp.* 216–234, *Sept.,* 1935.—The X-ray luminescence of quinolin and other nitrogen-containing organic bases can be highly increased by combination of these with strongly absorbing metallic salts. Only those compounds light up strongly in which the metal is attached to the nitrogen of the ring, that is, a part of the valency of the nitrogen must be externally saturated so that the organic molecule retains its power of vibration. On the other hand, the substitution of Cl in a metal chloride compound by I or Br, which are known to increase the tendency to complex salt building, leads to a decrease in luminescent intensity. Only those organic compounds are appreciably lit up by X-rays whose organic part photoluminesces in aqueous solution of the chlorhydrate. The spectral distribution under X-rays is the same as that of photoluminescence of the organic part. The mercury chloride compound with quinolin is some ten times as bright under X-rays as the photoluminescence of the corresponding chlorhydrate. The strongest luminescence was that of the mercury chloride of quinolin which is about one-sixth as bright as zinc silicate. The purer the organo-metallic compound the brighter the luminescence. There is no phosphorescence at room-temperature, but if irradiated at low temperature, subsequent heating gives phosphorescence. No irreversible change could be detected after many hours exposure. J. E.

See also Abstracts 4493, 4710.

HEAT.

CALORIMETRY.

4617. Effect of Aeration of Water Used in the Determination of the Mechanical Equivalent of Heat. T. H. Laby and E. O. Hercus. *Phys. Soc., Proc.* 47. *pp.* 1003–1011, *Nov.* 1, 1935.—In relation to Jessel's experiments [see Abstract 4615 (1934)] two matters are discussed. (i) The effects of the liberation of dissolved air on the specific heat of water. It is shown that heat of solution, surface energy, and latent heat of vaporisation contribute negligible amounts to the specific heat of water. A theory of the equilibrium of spherical air bubbles in fully aerated water is developed. (ii) The reliability of the existing evidence as to the value of the mechanical equivalent of heat. The conclusion is reached that Jessel's experiments do not invalidate the work of Jaeger and Steinwehr or of the writers on the mechanical equivalent of heat, and that the value as calculated by Birge, *viz.*, $4 \cdot 1852 \times 10^7$ erg/cal. at 15° C., is to be accepted. AUTHORS.

See also Abstracts 4631, 4635.

CONDUCTION.

4618. Thermal Conductivity of Insulating Materials. Y. Takamura. *Phys. Math. Soc. Japan, Proc.* 17. *pp.* 321–325, *Aug.*, 1935. *In English.*—A plate method is described for the determination of the thermal conductivity of slabs of insulating materials. The upper surface of the material is steam heated, and the lower surface is in contact with a Bunsen ice calorimeter, which is used to measure the heat flow through the material when the steady state is reached. The probable error is considered to be ± 3 %, and the following conductivities in C. G. S. units are given: sheet asbestos, 0·000696, fine sawdust (sp. gr. 0·28) 0·00014, coarse sawdust (sp. gr. = 0·174) 0·000128 and cotton wool (sp. gr. 0·046) 0·0000587. R. W. P.

***4619. Thermal Conductivity Apparatus. A. L. Fitch.** *Am. Phys. Teacher,* 3. *pp.* 135–136, *Sept.*, 1935.—One of the two heavy copper blocks is maintained at a constant temperature by a bath while the other changes in temperature due to heat conducted through a slab of the test material placed between the blocks. The thermal conductivity of poor conductors may be determined from readings of a stop watch and of a galvanometer connected to thermal couples imbedded in the blocks. AUTHOR.

CONVECTION.

4620. Problem in Heat Convection. T. Sasaki. *Tokyo Univ. Aeronaut. Research Inst., Reprint No.* 127, *pp.* 265–279, *Aug.*, 1935. *In English.*—The problem considered is that of the convection currents which are set up when streams of cold and warm fluids meet. W. Schmidt [see Abstract 480 (1912)] examined such a case experimentally and found that as the colder fluid passes beneath the warmer a vortex is set up, and mixing of the fluid takes place. Schmidt considered line squalls to result from actions of this nature. The present paper attempts to explain Schmidt's results theoretically. Several simplifying assumptions are made, and by introducing probable values for the constants involved a flow of the desired type is obtained. R. W. P.

DILATATION.

4621. Principal Expansion Coefficients of Single Crystals of Mercury. D. M. Hill. *Phys. Rev.* 48. *pp.* 620–624, *Oct.* 1, 1935.—The expansion coefficients were measured at 5° intervals from − 115° C. to − 160° C. and mean values found from − 160° C. to − 190° C. The upper temperature limit was set by a recrystallisation process which set in between − 115° C. and − 110° C. $\alpha_{\parallel}$ was found to be larger and to increase more rapidly with the temperature than $\alpha_{\perp}$. The volume coefficient plotted in conjunction with Carpenter and Oakley's measurements give values of the volume coefficient from the melting point to − 160° C. where the coefficient apparently begins to decrease rapidly with the temperature. AUTHOR.

4622. Thermal Expansion of Cast and Rolled Zinc. H. G. Jones. *Phys. Soc., Proc.* 47. *pp.* 1117–1128, *Nov.* 1, 1935.—The coefficients of expansion of cast and rolled zinc are measured under conditions of steady and of continuously increasing temperature, and marked differences between the coefficients are found to occur. On rolling, the random orientation of crystals in the cast specimen is broken up and most of the long axes are set perpendicular to the plane of rolling. No change is produced in the volume coefficient by rolling. When the zinc crystals are small, the continuous expansion is also small but as the size of the crystals increases, the continuous expansion also increases. Discontinuities in the continuous expansion are traced to the long axis of the crystals. AUTHOR.

MELTING AND BOILING POINTS.

4623. Freezing Point of Water (ψ_o-Limiting Values). W. Jacyna. *Zeits. f. Physik*, 97. 1–2. *pp.* 107–112, *Sept.* 23, 1935.—By means of the new ψ_o-relation together with the experimental data of Holborn, Otto, Heuse, Roebuck, Osterberg, etc., it is shown that the true ψ_o-value lies between the limits of 273·17 and 273·25° K. The calculation by means of the pressure dependent (μ, C_p)-values gives $\psi_o = 273 \cdot 22°$ K. The term $-\psi t\,(\delta am/\delta t)_p$ in the Joule-Thomson-ψ_o-expression has been redetermined. H. H. Ho.

4624. Melting Points and Lattice Structure. R. Forrer. *Ann. de Physique*, 4. *pp.* 202–269, *Sept.*, 1935.—The relation $T = FN^{\frac{1}{2}}$, where T is the absolute temperature of the Curie point, F a factor near 300°, and N the number of " contacts " [see Abstracts 3229 (1933) and 365 (1934)], is shown to give melting points by a suitable change in N, retaining similar values of F, the selection between the values of N deduced from the factors for Co (287), Fe (301) and Ni (315) being apparently made so as to give it a suitable value (it being admitted that nothing is known of the nature of F). The " contacts " (1–6 per orbit) are between the orbits of the required number of outermost electrons of adjacent atoms. The number of such electrons (the " lattice valency ") may or may not equal that of the ordinary valency electrons. (It is 1 for Li, Na, K, Rb, Cs, Ga, In, Tl, Zn, Co, Bi, Sn ; 2 for Pb, Mg ; and 3 for Ce, La, Cu, Ag, Au). The relations between the " electronic lattice " formed by these electrons, the rupture of whose contacts occurs on fusion, and the ordinary crystal lattice are detailed for the above elements, as also the connection with the dia-

or para-magnetism of the same and of certain alloys [see Abstract 3041 (1934)]. C. A. S.

See also Abstract 4453.

TEMPERATURE, MEASUREMENT OF.

***4625. Sensitive Vacuum Thermoelement. E. Picker and G. Rudinger.** *Zeits. f. techn. Physik,* 16. 9. *pp.* 265–268, 1935.—The factors affecting the sensitivity of vacuum thermo-junctions are briefly considered and an instrument is constructed in which a high sensitivity is obtained by employing a thermoelectric junction consisting of thin plates of Fe and constantan of thickness $0\cdot06\mu$ and $0\cdot5\mu$ respectively. These plates are prepared by distillation on a mica base. The sensitivity of the instrument compares favourably with that of other sensitive thermoelements. H. J. H. S.

***4626. Optical System of Disappearing Filament Pyrometer. F. A. Cunnold.** *Roy. Soc., Proc.* 152*A*. *pp*. 64–80, *Oct.* 15, 1935.—It is shown, both theoretically and experimentally, that reflection at the surface of the round filament is negligible in the usual type of disappearing filament optical pyrometer. The bright lines which may be seen at the edges of the filament are attributed to the deviations from Lambert's cosine law. A tentative theory of the diffraction effects at the edge of the filament is suggested and a simple deduction based on the same principles is shown to be in good agreement with the facts. Measurements made with pyrometers in which the disappearance of the filament may or may not be perfect indicate that perfect disappearance is not essential for the attainment of maximum accuracy. The influence of the edge effects on the design of optical pyrometers is discussed and it is shown that the aperture limits suggested by previous workers may be considerably widened so that pyrometers transmitting more light may be constructed and the optical temperature scale thereby extended downwards. AUTHOR.

See also Abstracts 4544, 4545, 4570, 4623, 4630.

THERMOCHEMISTRY.

4627. Heat of Dissociation of Metals from Recrystallisation Data. J. A. M. v. Liempt. *Zeits. f. Physik,* 96. 7–8. *pp.* 534–541, *Sept.* 7, 1935.—The heat of dissociation of metals may be calculated from recrystallisation data by means of the equation $E = 4\cdot6\ C + 1200\ \beta$, where E is the heat of dissociation in cal./gm. atom, C is the recrystallisation constant and β has a value which is dependent on the degree of deformation and is defined by the expression $\beta = (R_k - R_o)/R_o$ (R_k is the specific resistance of the deformed metal and R_o that of the undeformed). For Cu which is deformed by 10 %, C = 10,330 and $\beta = 5$. Approximately, $E = 4\cdot6\ C$ but to a closer approximation $E = 80\ T_R$, where T_R is the recrystallisation temperature, or $E = 32\ T_S$ where T_S is the melting point. Good agreement is found between the calculated and observed values of E. The diffusion formula of Langmuir and Dushman is modified by the introduction of a factor which gives a closer agreement with experimental values. H. J. H. S.

See also Abstracts 4449, 4549, 4553, 4597, 4631, 4645, 4695.

THERMODYNAMICS.

4628. Thermodynamics of Stationary Systems. Part I and II. B. Bružs. *Roy. Soc., Proc.* 151*A. pp.* 640–665, *Oct.* 1, 1935.—Part I discusses the thermo-element. A quantitative application of the first and second laws of thermodynamics to stationary systems is connected with an introduction of two arbitrary assumptions. The first of these—the non-interaction assumption of Lord Kelvin—leads to the two well-known Kelvin relations connecting the Seebeck, Peltier, and Thomson coefficients. The second assumption postulates the existence of a constant ratio between the Joule effect and the polarisation effect and leads to a new relation connecting the Seebeck coefficient with the thermal and electrical conductivities of the material. The whole problem of the thermo-element thus reduces to a knowledge of the thermal and electrical conductivities. Part II deals with the diffusion element. The non-interaction assumption of Kelvin leads here to two equations connecting the Helmholtz coefficient with that of Peltier and of the coefficient of the homogeneous effect. The assumption about the frictional effect leads to an equation connecting the Helmholtz coefficient with the coefficients of diffusion and electrical conductivity. The whole problem of the diffusion element thus reduces to the knowledge of diffusion and electrical conductivity. The knowledge of the electrical conductivity must, it is true, include the relative contributions of the energy carriers to the conduction of current (*e.g.*, Hittorf effect). This, the only difference compared with the thermo-element, naturally follows from the fact of the existence of more than one energy carrier in electrolytic systems. H. H. Ho.

4629. Heat Capacity, Entropy and Free Energy of Sulphur Vapour. I. Godnew and A. Sswerdlin. *Zeits. f. Physik*, 97. 1–2. *pp.* 124–130, *Sept.* 23, 1935.—The spectroscopic interpretation of the molecule S_2 is discussed. On the basis of spectroscopic observations the heat capacity, entropy and free energy of S_2 vapour are calculated in ideal gas conditions at temperatures between 100° and 5000° K. J. J. S.

4630. Heat Capacities and Entropies of Organic Compounds. Part I. Thermodynamic Temperature Scale from 12 to 273° K. J. G. Aston, E. Willihnganz and G. H. Messerly. *Am. Chem. Soc., J.* 57. *pp.* 1642–1646, *Sept.*, 1935.—The establishment of a temperature scale from 12–273° K. in terms of the copper-constantan thermocouple, using a helium thermometer, is described. An e.m.f. temperature reference table is given from 12–90° K. The scale is compared with the Leiden scale, using hydrogen and oxygen vapour-pressure thermometers.

AUTHORS.

4631. Specific Heat, Entropy and Dissociation of Gases and Vapours. E. Justi and H. Lüder. *Forsch. IngWes.* 6. *pp.* 209–216, *Sept.–Oct.*, 1935.—Values for the true and mean specific heats at constant pressure, and the entropy of H_2, D_2, N_2, O_2, HD, OH, CO, NO, H_2O, D_2O, CO_2, N_2O, SO_2 and air are calculated over the range 0°–3000° C., and tabulated for intervals of 100° C. The true and mean specific heats are given for CH_4, C_2H_2 and C_2H_4 between 0° C. and 1000° C. The variation of the two specific heats with pressure is considered, and tables are also compiled giving dissociation equilibrium constants, the degree of dissociation and the heat of dissociation for 13 different reactions over a wide range of temperatures. R. W. P.

See also Abstracts 4423, 4450, 4462, 4490, 4623, 4679.

VAPOUR PRESSURE.

4632. Dissociation Pressures of the Palladium-Hydrogen System. M. H. Hey. *Chem. Soc., J. pp.* 1254–1258, *Sept.,* 1935.—An equation developed from simple kinetic theory is shown to give a reasonably satisfactory account of the dissociation pressures of the palladium-hydrogen system, on the assumption that there is only one phase present throughout. The limiting composition of the system is PdH, which possibly has sodium chloride type structure. The equation is probably a first approximation to the truth. AUTHOR.

4633. Vapour Pressures of Solutions of Acids and Salts in Liquid Ammonia. A. I. Schattenstein and L. S. Uskowa. *Acta Physicochimica,* 2. 3. *pp.* 337–344, 1935. *In German.*—Measurements are made of the lowering of the vapour pressures of solutions of NH_4Cl, NH_4Br, NH_4I, NH_4NO_3, $NH_4C_2H_3O_2$, NaCl, and $NaNO_3$ in liquid ammonia at 15° C. and in the case of NaCl at 10° C. The densities of some of the solutions are also measured. The values of the osmotic coefficients for a range of concentrations of these electrolytes in liquid ammonia are derived, and compared with the results of other workers. R. W. P.

4634. Vapour Pressure of Krypton. E. Justi. *Phys. Zeits.* 36. *pp.* 571–574, *Sept.* 1, 1935. *From the Reichsanstalt.*—By means of an eddy-current cryostat previously described [see Abstract 718 (1934)] the vapour pressure of pure Kr is determined over the temperature range 73·30° K. to 121·16° K. The experimental results are tabulated and plotted. The triple point lies at $T = 116\cdot11 \pm 0\cdot10°$ K, and $p = 522\cdot2$ mm. Hg, and the normal boiling point is $120\cdot86 \pm 0\cdot10°$ K. The form of the sublimation curve supplies no evidence for the existence of an allotropic transformation in solid Kr within the range studied. R. W. P.

4635. Vapour Pressure of Barium. E. Rudberg and J. Lempert. *J. Chem. Phys.* 3. *pp.* 627–630, *Oct.,* 1935.—The vapour pressure of barium has been determined for temperatures from 525 to 750° C. by a method based on molecular effusion. The metal was obtained by decomposition of barium azide in a vacuum. The evaporated deposits were determined by microtitration to about 10^{-8} mole. The values obtained for the pressure range from 5×10^{-5} to 2×10^{-2} mm. They are well represented by the equation : $\log p$ (in mm.) $= 6\cdot99 - 8980/T$. This corresponds to a latent heat of evaporation of $4\cdot09 \times 10^4$ cal. mole. AUTHORS.

ACOUSTICS.

4636. Anomalous Propagation of Sound at a Short Distance. S. Syôno. *Geophys. Mag., Tokyo,* **9.** *pp.* 175–194, *Sept.*, 1935. *In English.*—In a former paper [see Abstract 2664 (1935)] the author examined by an approximate method some anomalous sound wave propagation phenomena described by J. Kölzer. The present paper, which is almost entirely mathematical, is concerned with making the treatment more rigorous by taking the effect of the wind and the absorbing effect of the earth's surface into account. J. E. R. C.

4637. Ultrasonics. E. Hiedemann. *Ergeb. d. exakt. Naturwiss.* **14.** *pp.* 201–263, 1935.—A comprehensive review of the subject of ultrasonics. An extensive Bibliography is appended. J. E. R. C.

4638. Production of Converging Ultrasonic Waves. J. Gruetzmacher. *Zeits. f. Physik,* **96.** 5–6. *pp.* 342–349, *Aug.* 31, 1935.—By cutting quartz in the form of a section of a spherical shell and then exciting its vibration parallel to the thickness a divergent wave is obtained on the one side and a convergent one on the other. Such radiators have been constructed with diameters and radii of curvature of the order of a few cm. and by immersing them in oil, various demonstrations are possible which show their focusing properties. In the case of one of these, actual measurements showed an increase of energy density near the focus by about 160-fold. J. E. R. C.

4639. Acoustical Roughness. G. v. Bekesy. *Zeits. f. techn. Physik,* **16.** 9. *pp.* 276–282, 1935.—It is found that the acoustical roughness of two tones can with practice, be compared by ear with some accuracy. A standard roughness is taken to be that of a 3000 ∼ note modulated with a 50 ∼ note. The intensity of the standard note is varied until its roughness is deemed to be equal to that of the note whose roughness is being measured. The absolute intensity of the standard note in dynes/sq. cm. is then taken to be a measure of the roughness. The variation of the roughness with fundamental frequency is examined and the results compared with calculations of Helmholtz. The roughness of pure tones is also determined and for a tone of effective sound pressure 5 dynes/sq. cm. is found to increase from just perceptible at 1000 ∼ to measurable at 350 ∼ and up to 0·01 dyne/sq. cm. at 50 ∼. The fatigue phenomenon of decreasing loudness of a constant amplitude note with time is found to be reduced from 20 db to 3 db if instead of a 1000 ∼ pure tone a 1000 ∼ note modulated with 5 ∼ is used. The importance of this in noise measurements is pointed out.

J. E. R. C.

4640. Physics of Speech Sounds. F. Trendelenburg with E. Franz. *Acoustical Soc. of America, J.* **7.** *pp.* 142–147, *Oct,* 1935.—It is difficult to determine the composition of aperiodic sound phenomena, particularly those which vary rapidly with time, as, for example, speech sounds. The methods of automatic electric analysis cannot be applied directly because of the time required. The graphic or mechanical Fourier analyses cannot be recommended because a great number of single analyses must be carried out for aperiodic processes. A very clear idea of the sound composition as a function of time is obtained when the separate octave ranges of the sound processes are recorded oscillographically by means of filters. The result of such oscillographic investigations of speech sounds is described. The oscillograms very clearly show the different harmonic and inharmonic components of speech sounds. Conclusions in regard to the voice theory are drawn from the oscillograms. AUTHORS.

4641. Acoustical Work of the National Bureau of Standards, Washington. V. L. Chrisler. *Acoustical Soc. of America, J.* 7. *pp.* 79–87, *Oct.*, 1935.—A general account is given of the development of the acoustical section of the Bureau of Standards since 1922 and of the equipment and methods for measurements of sound transmission and absorption. Reference is made to a number of papers by the author and others giving fuller details. A. W.

4642. Mechanical and Acoustic Impedance. F. Bedeau. *J. de Physique et le Radium*, 7. *pp.* 383–387, *Sept.*, 1935.—A short exposition is given of some of the methods of calculation utilised to-day by electro-acoustic engineers. Electric circuits are classified in two large groups. The first group comprises the circuits whose dimensions are sufficiently small with respect to the wave-length for the telegraphic equation not to be applicable. These circuits lead to the idea of mechanical impedance. The second group comprises the circuits whose dimensions are such that it is necessary to utilise the telegraphic equation; these circuits lead to the idea of acoustic impedance. A number of particular cases are discussed. A. W.

4643. Acoustic Impedance of Small Orifices. L. J. Sivian. *Acoustical Soc. of America, J.* 7. *pp.* 94–101, *Oct.*, 1935.—Data are presented giving the measured acoustic reactance and resistance for a number of circular orifices varying in dia. from 1 cm. down to 0·034 cm. and for a rectangular orifice 1·9 cm. × 0·075 cm. The measurements were made for various particle velocities, the corresponding Reynolds numbers varying from 0·7 to 3000, roughly. The reactance is found substantially independent of the particle velocity; a formula for computing it is given. The resistance approaches a constant value as the velocity is sufficiently decreased; formulae for computing this "low velocity" resistance are given. At larger velocities the resistance increases with the velocity. This is discussed from the standpoint of a loss of kinetic energy of flow, acting besides viscosity and turbulence. AUTHOR.

See also Abstracts 4464, 4550.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

***4644. Electronic Bridge Balance Indicator for Conductance Measurements. R. L. Garman and G. F. Kinney.** *Indust. and Engin. Chem.* (*Analytical Edition*), 7. *pp.* 319–320, *Sept.* 15, 1935.—A single valve may be used as a bridge balance indicator which in a suitable arrangement has a sensitivity equal to that of the best headphones. In using this electronic indicator to its best advantage, important factors are shielded impedance-matching transformers and proper earthing arrangement such as a Wagner earth. AUTHORS.

See also Abstracts 4642, 4672.

CONDUCTION AND DISCHARGE IN GASES.

4645. Spark Ignition of Low Inflammable Gas Mixtures. Part III. K. Yumoto. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 891. *pp.* 275–285, *Sept.*, 1935. *In English.*—Continuing previous work [see Abstract 4978 (1933)] the presence of nitrogen in a low inflammable mixture of H_2 and O_2 is found to decrease the energy required for spark ignition for N_2 concentrations up to 5 % after which a continual increase in energy is necessary. The mechanism of ignition produced by the ordinary spark from a spark coil with no additional capacity is different from that of a capacity spark. It is concluded that spark ignition is closely connected with the prior excitation of molecules to suitable energy levels and with the nature of the nitrogen compounds which are produced by the discharge. F. C. C.

4646. New Effect in Wires with Corona Discharge. A. Güntherschulze and H. J. Hesse. *Zeits. f. Physik*, 97. 1–2. *pp.* 113–123, *Sept.* 23, 1935.—If a thin wire is stretched loosely in a horizontal or perpendicular direction between two fixed points and experiences at the same time a corona discharge and a heating current it is set in lively rotation round the line joining the fixed points. The dependence of the velocity of rotation on the amplitude of the wire, the pressure of the air, the magnitude of the heating current, the voltage of the corona and the length of the wire are investigated. The following explanation is given. The wire is heated and the heat imparted to the surrounding air. On application of the high voltage the wire is set in motion through electrostatic attraction, and the air on the front side is cooler than on its back whither the heated air streams. Then the density of the corona current, the ionic density and the repulsive force are greater at the back than at the front, and thus the motion already commenced is increased. The force producing this motion combined with centrifugal force results in a motion of rotation of the wire round the line joining the fixed points as an axis. J. J. S.

4647. Effect of Glass Walls on the Establishment of Striations in the Positive Column. E. Badareu and G. Maciuc. *J. de Physique et le Radium*, 7. *pp.* 365–368, *Sept.*, 1935.—A discharge is produced between disc electrodes in a large glass container, with air at pressures of about 0·3 mm. Hg; the positive column is then very short. Without changing the discharge conditions a glass cylinder 2·5 cm. in dia. is allowed to slip over the anode and gradually enclose the discharge. As the tube advances luminous striations break away from the anode and move down the tube; the kathode glow remains unchanged. The effect is similar to what would be produced if the electrode separation were decreased. At the same time, apparently due to diffusion of the discharge to the glass, the tube current drops by about 10 %. The potential distribution in the discharge was investigated by means of a movable probe wire. When the discharge is completely surrounded, the potential curve is that normally observed in a striated discharge. If the probe is fixed, and observations of the potential made as the surrounding tube advances, regular fluctuations of potential appear. J. E. R.

4648. Anchoring the Mercury-Pool Kathode Spot. L. Tonks. *Physics*, 6. *pp.* 294–303, *Sept.*, 1935.—Certain metals projecting through a mercury surface have the property of anchoring the kathode spot. This was found to be the case for all the metals tried, Fe, Pd, Zr, Pt, Cr, Cb, Ir, Mo, Ta and W. The property depends upon wetting of the metal by the mercury and this, in turn, depends upon having a clean metallic surface. The spot lengthens into a fine bright kathode line at the meniscus edge. This line consists of a multitude of small emitting areas which are in constant rapid and chaotic motion. The details, as shown by moving film photographs, differed with the metal used. A. W.

4649. Voltage-Current Characteristics in Gas Discharge Tubes with Neither Hittorf Dark Space nor Kathode Fall of Potential. H. Schnitger. *Zeits. f. Physik*, 96. 7–8. *pp.* 551–558, *Sept.* 7, 1935.—This paper is a continuation of work reported [see Abstract 757 (1934)] upon glow discharges in tubes with neither Hittorf dark space nor kathode fall of potential. The conditions for this type of discharge were that the cold kathode should be in two parts (1) a material of specific resistance between that of graphite and a semi-conductor and (2) a thin coating of very high insulating material. In the present paper the gases were purified with liquid air and by gettering with Na or Mg and an "ocelit" low resistance kathode was used (50 and 100 ohms). These refinements gave such a constancy to the discharge that voltage-current characteristics could be measured. For hydrogen and nitrogen at pressures of 0·05 tor. (mm. Hg) the voltage-current curve conforms to the law $I = AV^2e^{-B/V}$, where A and B are constants, for the current range 1 : 89. Similar curves were obtained with oxygen, helium, neon and argon. A. C. W.

4650. Fall of Potential in the Negative Dark Space of Normal Glow Discharges. W. H. Ernst. *Helv. Phys. Acta*, 8. 5. *pp.* 381–404, 1935.—The so-called probe characteristics were determined in the Faraday dark space, the negative glow and the Crookes dark space for normal H_2 and A for various gas pressures employing both hot and cold probes. Curves of typical results are given which show abnormal characteristics in the region of the Faraday dark space and part of the negative glow. The results are compared with those of other workers and the Compton-Morse theory is employed as a basis of explanation of the observed phenomena. R. L.

4651. Phenomena of Currents between a Small Hot Kathode and a Very Large Anode for Glow Discharges in Different Gases. F. Keller. *Zeits. f. Physik*, 97. 1–2. *pp.* 8–33, *Sept.* 23, 1935.—In the rare gases diffusion currents and potential gradient currents must be differentiated. Diffusion currents occur when the electron density in front of the kathode is great enough to maintain the necessary concentration gradient. Such diffusion currents are found, both theoretically and experimentally, to follow the law $i = C/r^3$. Potential gradient currents are found when the electron density in front of the kathode is too small for maintenance of the necessary concentration gradient. Such currents are found, both theoretically and experimentally, to follow the law $i = CL_0/r^3L$, where L_0 is the perpendicular from kathode to anode and L the length of the electric line of force. In molecular gases gradient currents and ionic mantle currents are possible. Since nitrogen has a measurable gradient, it would be expected to exhibit gradient currents. Experiments with nitrogen indicate that this is the case, but do not definitely confirm it. Ionic mantle currents were not observed. In the case of hydrogen the law $i = CL_0/r^3L$ is only true for the mean plane between kathode and anode. Reasons for this are given. Ionic mantle currents were observed with oxygen, the discharge forming a fairly sharply defined pipe whose diameter was about equal to that of the kathode, while for water vapour it was appreciably smaller. A. W.

4652. Development of a Spark from a Glow. E. L. E. Wheatcroft and H. Barker. *Phil. Mag.* 20. *pp.* 562–571, *Oct.*, 1935.—An experimental arrangement is described in which a series of discharges can be passed between spherical electrodes under varying conditions of pressure and electrode spacing. This discharge may be a glow or a spark according to the electrode separation and the gas pressure. A spark is defined as occurring when the central bright core of the discharge passes through the Faraday dark space. Three methods are described for determining the critical pressure at which the glow discharge changes to a spark and *vice versa*. Curves are given showing the variation of critical pressure with electrode spacing and with tube current, the latter being varied by the introduction of a discharge resistance. Test experiments show that electrode capacity and humidity of the air do not affect the results. [See following Abstract.] J. E. R.

4653. Paschen's Law at Low Striking Potentials. E. L. E. Wheatcroft and H. Barker. *Phil. Mag.* 20. *pp.* 571–578, *Oct.*, 1935.—In the pressure range in which a discharge may be a glow or a spark, previous tests of Paschen's law, that sparking voltage between parallel electrodes is a function only of pressure and electrode spacing, have been few and inconsistent. Using apparatus previously described [see preceding Abstract] striking potentials in dry air have been measured under a number of conditions of pressure and electrode spacing. It is concluded that the law does hold good over the range of 1 to 4 kV and typical experimental results are given. The difference between spark and glow is small, the striking potential of the former being consistently some 50 to 100 V lower. J. E. R.

4654. Theory of Glow Discharge. E. L. E. Wheatcroft. *Phil. Mag.* 20. *pp.* 578–586, *Oct.*, 1935.—Previous work on the relation between breakdown voltage of a gas between parallel electrodes, and the product of pressure *p* and electrode spacing *d* is discussed. It is suggested that the main features of a maintained glow discharge may be explained in terms of the same relationship, thus showing that no new ionisation processes are involved. The main features investigated are (1) the normal kathode fall and (2) the increasing kathode fall which accompanies a forced rise of current density. An experimental arrangement is described and curves are given showing the relation between maintenance potential and the product *pd* for the abnormal and normal kathode fall cases are given.

Although absolute values of minimum maintenance potentials cannot be obtained with accuracy, the results do establish the suggested essential inter-relation between the breakdown and the kathode fall curves.

J. E. R.

4655. Spectroscopic Observation of Recurrent Phenomena in Discharge Tubes. R. H. Sloane and C. M. Minnis. *Phys. Soc., Proc.* 47. *pp.* 1019–1028, *Nov.* 1, 1935.—A method for the synchronous photography of irregular moving striations is described. It consists in forming an image of the positive column of a discharge along the slit of a spectrograph and covering and uncovering the latter with a mechanical shutter made to synchronise with the striations by a photoelectric device. The spectra obtained show variations in intensity along each line, corresponding to the intensity of the line in the bright and dark phases. Direct photography also of the actual striations is described. The photographs obtained for pure A show that there is no appreciable recombination in the dark phase, while those for A-Hg mixtures show excitation of only the Hg lines in the dark phase. These results have been explained by assuming that in the dark phase the electron energies are high enough to excite the mercury lines and are therefore too high to permit of recombination taking place. It is only in the bright phase that the energies are large enough to excite the A lines. The optical results described are in accord with data obtained by Pupp by an electrical method. Their bearing on the work of Ladenburg is also discussed. AUTHORS.

4656. Ionisation by Kathode Rays in Air. W. Gerbes. *Ann. d. Physik,* 23. 7. *pp.* 648–656, *Sept.,* 1935.—The ionisation produced in air by kathode rays is usually defined in terms of the energy loss per ion pair. Eisl recently made an accurate determination of this loss and obtained a value of 32·2 ± 0·5 V for the range 10-60 kV. Eisl's method is examined and criticised and a number of corrections are made. An empirical formula is derived experimentally for the relation between the energy loss per ion pair and the accelerating potential over the range 0·3—60 kV. The term " differential loss per ion pair " is introduced to replace the term " energy loss per ion pair " for that region where the loss is dependent on the accelerating potential and a simple method of deriving one from the other is given. H. J. H. S.

4657. Chemical Reaction in the Electric Discharge. Part I. Impulse Discharges. E. J. B. Willey. *Roy. Soc., Proc.* 152*A*. *pp.* 158–171, *Oct.* 15, 1935.—In this paper it is shown that Wrede's results for nitrogen [see Abstract 2100 (1929)] may be confirmed by chemical means and by simpler apparatus, and that the controlled impulse discharge is very superior, both as regards absolute and power yields as compared with a.c. and d.c. discharges. It does not seem possible, in the absence of very complete quantitative data upon the spectra developed in nitrogen, when equivalent amounts of power are applied in different ways, to offer definite explanations as to the very great superiority of the impulse discharge over the other types, both as regards absolute and power yields of the active nitrogen, but, on the balance of evidence, it is opined that the impulse discharge favours first the initial production of atoms through inducing those states of the parent-molecule in which it dissociates most easily, and later conserves them. The other types are both much less fruitful as regards the primary yield and also highly destructive, by reason of their continuous nature, upon the small amounts of reaction product actually generated. The very short duration of the impulse discharge is also very beneficial in preventing their excitation to higher levels in which they can either recombine more easily than usual, probably in purely bimolecular reactions, or cease to exhibit the characteristics which give active nitrogen its somewhat unique properties. H. H. Ho.

***4658. Tube Counters with Alkali Kathodes. W. Christoph.** *Ann. d. Physik*, 23. 8. *pp.* 747–760, *Sept.*, 1935.—Geiger-Müller tube counters filled with H_2, N_2 and A or mixtures of these and with alkali kathodes are constructed which are sensitive in the visible spectrum and which have similar characteristics of range, sensitivity and stability to those of the ordinary tube counters. The production of a sensitivity independent of the applied potential over a wide range depends on the size and nature of the kathode and on the arrangement of the components of the counter. Instability is attributed to alternation between pure gas discharge and action at the kathode. F. C. C.

***4659. Breakdown Voltage between Metal Electrodes in a Vacuum. H. W. Anderson.** *Rev. Sci. Instruments*, 6. *pp.* 309–314, *Oct.*, 1935.—This paper describes apparatus used for the measurement of breakdown voltages between electrodes in a vacuum with potentials up to the order of 500 kV. The use of a direct voltage of this magnitude required special shielding to limit electrical stresses in the lead-in bushing of the vacuum tank. The source of power was an electrostatic belt generator with a corona-leak voltage control. Voltage was measured with a xylene-alcohol high-resistance voltmeter. Incidental work with stand off insulators in a vacuum is described. The results of a series of breakdown measurements are shown with a curve. AUTHOR.

See also Abstracts 4434, 4575, 4608, 4644, 4674.

CONDUCTION IN SOLIDS AND LIQUIDS.

4660. Application of Dirac's Density-Matrix Method in the Theory of Metals. S. Sǔbin. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 3. 1. *pp.* 15–18, 1935. *In German.*—It is suggested that the effect of external fields of force on the electron gas in a metal could be much simplified by the use of the Dirac density-matrix for the electrons. The case when the external force is that due to an electric field of arbitrary frequency, is worked out in detail as an illustration. G. C. McV.

***4661. Line-Operated Valve Voltmeter. R. L. Garman and M. E. Droz.** *Indust. and Engin. Chem.* (*Analytical Edition*), 7. *pp.* 341–342, *Sept.* 15, 1935.—A self-contained valve voltmeter is described, capable of operating on a.c. or d.c. lines, and designed to minimise the effects of line-voltage variations. The circuit employs a double diode valve (6A6) connected in a bridge manner, and the conditions for stability are investigated. The response characteristic is linear. G. E. B.

***4662. Short-Period Electrometer. J. Frank.** *Phys. Zeits.* 36. *pp.* 647–648, *Oct.* 1, 1935.—An electrometer built like a quadrant electrometer, but possessing the properties of a string electrometer. The quadrants are four vertical wires set at the corners of a square. The needle is a very thin strip of Al foil, carrying a small mirror, and suspended by Pt wires or silk threads in tension, the axis of the needle coinciding with that of the suspension. The period depends on the sensitivity but is of the order of 0·2 sec. The instrument is as transportable as the string electrometer. L. H.

***4663. Anomalous Behaviour of a Vibration Galvanometer. L. M. Chatterjee.** *Zeits. f. Physik,* 96. 11–12. *pp.* 720–725, *Sept.* 18, 1935.—Vibration galvanometers of the bifilar type sometimes have several modes of vibration in addition to the fundamental one, so that the observed spot of light may trace curves like Lissajous' instead of a horizontal straight line. Similar effects have been observed with a unifilar galvanometer over a band of frequencies (765–810 ∼) a little below the normal frequency of resonance (830 ∼). As the impressed frequency was slowly increased from 765, the band of light changed successively from a horizontal line to a tilted line, a tilted narrow ellipse, a broader ellipse with major axis horizontal (at 794 ∼); these changes being retraced in the reverse order as the frequency was further increased to 810 ∼. L. H.

***4664. Construction of Sensitive Moving-Coil Galvanometers. A. C. Downing.** *Journ. Sci. Instruments,* 12. *pp.* 277–281, *Sept.*, 1935.—An account is given of the technique developed for the construction and the mounting of extremely light galvanometer coils. The current sensitivities quoted range from 1×10^{-10} to 10×10^{-10} A for 1 mm. deflection at 2 m. for suspensions possessing moments of inertia of 1×10^{-4} and $3 \cdot 7 \times 10^{-4}$ gm. cm.^{2} T. I. J.

4665. Theory of Supraconductivity. M. v. Laue, F. and H. London. *Zeits. f. Physik,* 96. 5–6. *pp.* 359–364, *Aug.* 31, 1935.—The production of heat by a stationary current is discussed in the light of the recent theory of supraconductivity suggested by F. and H. London. [See Abstracts 1797 and 2697 (1935).] R. W. P.

4666. Resistance of Hydrogen-Charged Wires of Pd-Au and Pd-Ag Alloys. A. Sieverts and H. Hagen. *Zeits. f. phys. Chem.* 174, *Abt.A.* 3–4. *pp.* 247–261, 1935.—A continuation of previous work [see Abstract 3766 (1933)] using a similar experimental method. Pressure-concentration isotherms are given and discussed for alloys with 5 and 10 % Ag and are similar to those of pure Pd; at 155° C. they show hysteresis and at 200° C. a section almost independent of pressure. All other isotherms are parabolic. Pressure-resistance isotherms for alloys up to 60 % Ag are also discussed. The behaviour of Pd-Ag and Pd-Au alloys was found to be somewhat similar. R. L.

4667. Electrical Conductivity of NaCl Crystals. Z. Gyulai. *Zeits. f. Physik,* 96. 3–4. *pp.* 210–218, *Aug.* 22, 1935.—Pastilles were prepared by compressing powdered NaCl at different pressures and temperatures. The electrical conductivity was measured, and it was found that after prolonged annealing of the pastille the value of the work required to free the ions approached, at temperatures up to 500° C., the accepted value for single crystals. Above 500° C. a much larger value was found. These two values can be explained by the Kossel theory of crystal growth. Polarisation potentials were found to appear after prolonged annealing. D. H. F.

4668. Structure of Electrolytic Solutions. H. Falkenhagen. *Ergeb. d. exakt. Naturwiss.* 14. *pp.* 130–200, 1935.—This survey is divided under three main headings in which various theories are elaborated and discussed. The headings are; general bases and hypotheses of the Milner-Debye theory of strong electrolytes; comparison of experimental and theoretical results of the interionic theory; concentrated electrolytic solutions. A Bibliography containing 257 references is included. R. L.

***4669. D.C. Measurement of Electrolytic Conductance. J. N. Brönsted and R. F. Nielsen.** *Faraday Soc., Trans.* 31. *pp.*

1478–1481, *Oct.*, 1935.—The use of d.c. where applicable, is recommended as a substitute for a.c. for the accurate determination of conductivities of solutions. Advantages of the method include simplicity of apparatus and procedure as compared with that necessary to obtain the degree of accuracy with a.c., especially in the case of solutions with low conductivities. A simple apparatus and procedure are described by which conductivities of acid and basic aqueous solutions may be determined with high accuracy. Examples are given for HCl and H_2SO_4 solutions ranging from 0·1 to 0·001 *N*. AUTHORS.

4670. Conductivity of Glasses. R. L. Müller. *Acta Physicochimica*, 2. 1. *pp*. 103–125, 1935. *In German.*—This investigation deals with the electrical conductivity of glass-like alkali borates, which occupy a position intermediate to those of crystals with ion lattices and liquid salt solutions. Frenkel's theory of electrical conductivity is shown to be applicable in these cases, if the necessary temperature correction is taken into account. The association of polar molecules in glasses and its influence on conductivity are considered. With the boron and silicate glasses examined—which are rich in polar salt-like molecules—the relation $Am^{1/x}$ = const. is found, A being the coefficient in the formula for electrical conductivity $ln\,\chi = -A/T + B$, and m the molar concentration. With the boron glasses χ is about 2 and with the silicate glasses about 4.

T. H. P.

See also Abstracts 4449, 4520, 4628.

DIELECTRICS AND CAPACITANCE.

4671. Resonance Method of Determining Dielectric Constants. F. Hummel. *Zeits. f. techn. Physik*, 16. 9. *pp*. 264–265, 1935.—The measurement condenser and a standard variable air condenser are arranged so that either can be connected in the lead between an aerial and a receiver, a switch changing the aerial connection from one to the other. The receiver, with measurement condenser connected, is tuned to an incoming wave and after switching over to the standard condenser the latter is varied till the receiver is again in tune. Two such settings, without and with the dielectric between the plates of the test condenser, give at once the dielectric constant of the material. Auxiliary fixed condensers are used if the dielectric constant is high, bringing the capacity beyond the range of the variable condenser, a suitable maximum value for this being 500 cm. A. W.

***4672. Dielectric Constants of Aqueous Solutions of Strong Electrolytes. E. Fischer.** *Phys. Zeits*. 36. *pp*. 585–593, *Sept*. 1, 1935. —An a.c. bridge is described consisting of four capacitance-arms for measurements on electrolytes at frequencies of 10^6 to 10^7 c/s. The loss angle of the condenser containing the electrolyte is balanced by a variable, electrolytic resistance connected across the adjacent arm. The resistance consists of a capillary tube containing a solution of H_2SO_4 and its value is adjusted by altering the concentration of the acid. An accuracy is claimed for the dielectric constant of 0·03 to 0·2 % according to the concentration of the solution. Measurements obtained with solutions of NaCl, Na_2SO_4, $Ca(NO_3)_2$, $MgSO_4$, $CaSO_4$, $CdSO_4$, and $Ba_2Fe(CN)_6$ showed increments in dielectric constant over that of water, which confirmed in general the Debye-Falkenhagen theory of strong electrolytes. T. I. J.

4673. Dipole Induction and the Solvent Effect in Dipole Moment Measurements. F. C. Frank. *Roy. Soc., Proc.* 152A. *pp.* 171–196, *Oct.* 15, 1935.—A theory is developed accounting for the influence of the solvent upon the apparent dipole moment observed by Müller, Jenkins and others. It is an extension of the ideas of Weigle and Higasi. It leads to a classification of molecular geometry with very different solvent effects in different classes. The empirical laws put forward by Müller and others apply only to a single class. The measurements analysed are in good qualitative and approximate quantitative agreement with the theory. The theory also leads to important conclusions regarding dipole induction in radicals forming part of the polar molecule. A number of special points such as the attraction of solvent molecules by dipole forces, the influence of anisotropic and polar solvents, the evidence of dielectric constant measurements in water on the structure of *Zwitterionen*, and the form of the dispersion curve in polar liquids, are discussed in the light of the same theory. AUTHOR.

4674. Electric Breakdown in Gases and Solid Insulators. A. v. Hippel. *Ergeb. d. exakt. Naturwiss.* 14. *pp.* 79–129, 1935.—A lengthy and copiously illustrated survey of these phenomena with a Bibliography. Part I deals with breakdown in gases and Part II with breakdown in solids; at the end of each part the insulating properties of gases and solids respectively are tabulated. R. L.

4675. Dependence of the Dielectric Properties of Rochelle Salt on Mechanical Conditions. R. David. *Helv. Phys. Acta*, 8. 5. *pp.* 431–484, 1935.—The connection between the electrical properties and the elastic distortion of Rochelle salt crystals is investigated. The crystals exhibit dielectric hysteresis and saturation. For small field strengths under 50 V/cm. no hysteresis is present. In this region the polarisation varies proportionally and reversibly with the field strength. If a mechanical pressure is applied to the crystal the hysteresis curve becomes asymmetrical; but the reversible part for small fields persists. The dielectric constant of the reversible part decreases with increasing pressure. From this it can be concluded by analogy with the ferromagnetic theory that the dielectric constant of the reversible part depends on the "boundary displacement" of the spontaneously polarised domains. The spontaneous polarisation is determined by the distortion of the domains. On these assumptions and for small field strengths the dependence of the dielectric constant can be calculated from the laws of the piezoelectric effect. It appears from the good agreement between experiment and calculation that the spontaneous polarisation is determined regionally by the distortion. The influence of the crystal water content on the dielectric properties is attributed to the different structure distortions caused by the varying water content from place to place. L. E.

4676. Dielectric Properties of Aluminium Oxide Films. H. Zauscher. *Ann. d. Physik*, 23. 7. *pp.* 597–626, *Sept.*, 1935.—The dielectric properties of aluminium oxide films produced by d.c. electrolysis are investigated. The dielectric constant and power factor increase—and the porosity decreases—with increasing film thickness up to 50 μ, and are then independent of thickness, the values of dielectric constant and power factor now being 7·0 and 0·0034 respectively. The power losses increase with rise of temperature, electrolytic conduction being pronounced at high temperatures. With oil-impregnated films, a decrease of power loss with increasing voltage is reported at high temperatures. E. R.

4677. Dielectric Losses in Electrolytic Rectifiers for Extreme Field-Strengths to 10^7 V/cm. A. Güntherschulze and H. Betz. *Zeits. f. Physik*, 96. 9–10. *pp.* 686–690, *Sept.* 12, 1935.—The dielectric losses (expressed conveniently as phase-angles) for Al and Ta rectifiers were studied and among others the following results were obtained: (*a*) With increasing field strength (a.c.) tan δ rises for both Al and Ta; (*b*) For a given a.c. field strength, the losses in Ta rectifiers fall with increasing d.c. field strength, while for Al rectifiers tan δ remains constant to 6×10^6 V/cm. d.c. and then rises sharply; (*c*) For Ta, tan δ rises linearly with temperature; (*d*) For Ta, tan δ falls with increasing frequency, and is substantially constant from 400–800 ∼. G. E. B.

***4678. Routine Instrument for Measuring Small Capacities. J. L. Spencer-Smith.** *Journ. Sci. Instruments*, 12. *pp.* 316–318, *Oct.*, 1935.—The paper describes a circuit which has proved suitable for routine work in measuring small changes of capacitance. The circuit has been used for measuring the moisture content of textile fabrics and has proved suitable for studying by means of a kathode-ray oscillograph, the variation in tension of the warp threads in a loom during weaving. AUTHOR.

See also Abstracts 4520, 4737.

ELECTROCHEMISTRY.

4679. Relation between E.M.F. and Heat of Reaction of Lead Accumulator. F. Ishikawa. *Tohoku Univ., Sci. Reports*, 24. *pp.* 180–191, *July*, 1935. *In English.*—The double sulphate theory proposed to account for the cell reaction of the lead accumulator is discussed in the light of the theory of N. Kameyama. The correct value for the differential heat of solution of sulphuric acid at infinite dilution is employed. The theory is examined by comparing the values for the reaction heat, which were obtained from E and dE/dT, and by combining the accurate differences between the heats of formation of sulphuric acid and of lead sulphate with accurate data for the other substances concerned. The double sulphate theory may be considered to be correct within the limits of experimental error. F. J. B.

4680. Electrolytic Separation of Lithium Isotopes. A. Eucken and K. Bratzler. *Zeits. f. phys. Chem.* 174. *Abt.A.* 3–4. *pp.* 269–272, 1935.—Attempts at the electrolytic separation of the Li isotopes by electrodeposition from a solution of Li_2SO_4, using a mercury jet as kathode, gave results indicating that the change of atomic weight of the deposited Li was only of the same order of magnitude as the possible experimental error. J. S. G. T.

4681. Electrolytic Separation Factor of Hydrogen Isotopes. A. Eucken and K. Bratzler. *Zeits. f. phys. Chem.* 174. *Abt.A.* 3–4. *pp.* 273–290, 1935.—As the result of experiments in which kathodes composed of Pt, Au, Ag, Cu, Pb, and graphite were used in the electrolytic separation of H isotopes, the D-content of the gas evolved being determined by measurement of its thermal conductivity, values of the separation factor ranging from 2–7 to 17 were obtained; only in the case of a mercury kathode was the value of the factor throughout below 5. No parallelism between separation factor and overvoltage of the kathode metal concerned was found. However, it was found that anodic pretreatment of the kathode metal increases considerably the value of the separation factor, while addition of materials similar to the alkaloids in character, *e.g.*, α-naphthachinolin, depresses the value of the factor to between 3 and 4. The value of the factor appears to be increased by increased current density in cases where it is initially relatively large. The results are discussed theoretically. J. S. G. T.

4682. Concentration of Heavier Oxygen Isotopes in Commercial Electrolytic Cells. W. H. Hall and H. L. Johnston. *Am. Chem. Soc., J.* 57. *pp.* 1515–1517, *Sept.*, 1935.—The enrichment in O^{17} and O^{18} of electrolytes from commercial cells in operation for over seven years determined by two methods (normalisation of the O isotopes by CO_2, and separation of the O by electrolysis and subsequent recombination with tank H), followed by density determinations amounted to 4 p.p.m. in density. [See Abstract 2242 (1935).] C. A. S.

4683. Efficiency of Separation of Hydrogen and Deuterium by Electrolysis. T. H. Oddie. *Phys. Soc., Proc.* 47. *pp.* 1060–1067, *Nov.* 1, 1935.—A method of determining the efficiency of concentration of D_2O by electrolysis of mixtures of H_2O and D_2O is described; it takes account of the effects of losses by evaporation and spraying. It is found that the H-ion concentration of the electrolyte and the nature of the electrodes do not affect the efficiency α, but α increases with increasing current-density. The coefficient α is found to be $4 \cdot 0 \pm 0 \cdot 2$ with current-density $0 \cdot 6$ A/cm^2., and $4 \cdot 6 \pm 0 \cdot 1$ with current-density 2 A/cm^2. These results are in agreement with values predicted theoretically by Urey and Teal. AUTHOR.

4684. Ionisation Constants of Carbonic Acid. D. A. MacInnes and D. Belcher. *Am. Chem. Soc., J.* 57. *pp.* 1683–1685, *Sept.*, 1935.—The first and second ionisation constants for carbonic acid have been determined at 38° from e.m.f. measurements on galvanic cells without liquid junctions. [See Abstract 4244 (1933) and following Abstract.] AUTHORS.

4685. First Ionisation Constant of Carbonic Acid. T. Shedlovsky and D. A. MacInnes. *Am. Chem. Soc., J.* 57. *pp.* 1705–1710, *Sept.*, 1935.—New measurements have been made at 25° on the conductances of solutions of CO_2 and of $KHCO_3$. The relative conductances at 0, 15, 25 and 38° of saturated CO_2 solution and of $KHCO_3$, KCl and HCl at $0 \cdot 001$ *N* have also been determined. From these data the thermodynamic dissociation constant of carbonic acid as a monobasic acid has been obtained for the temperatures given. These values have been used in obtaining equations by means of which the ionisation constant K_1 and the heat ΔH of the reaction $H_2O + CO_2 = H^+ + HCO_3^-$ are expressed as functions of the temperature. The values of the constant K_1 are $4 \cdot 31 \times 10^{-7}$ at 25° and $4 \cdot 82 \times 10^{-7}$ at 38°, in reasonable agreement with the corresponding values $4 \cdot 5 \times 10^{-7}$ and $4 \cdot 9 \times 10^{-7}$ obtained by MacInnes and Belcher at these temperatures. [See preceding Abstract.] AUTHORS.

4686. Migration of Ions as a Kinetic Molecular Problem. A. Magnus. *Zeits. f. phys. Chem.* 174. *Abt.A.* 3–4. *pp.* 262–268, 1935.—The assumption that between every two collisions of ions with molecules of the solvent the ions are accelerated in the direction of the electric field and again retarded by the collision leads to a constant speed of migration of ions in the electric field. From the observed ionic mobilities the mean free path can be calculated and is found to be much smaller than the calculated molecular kinetic value, especially in the case of small and doubly charged ions. This deviation points to a dipole structure of the solvent. R. L.

4687. H-Ion Mobility in Aqueous HCl-$CaCl_2$ Mixtures L. G. Longsworth. *Am. Chem. Soc., J.* 57. *pp.* 1698–1700, *Sept.*, 1935.—The transference numbers of the H-ion constituent in aqueous mixtures of HCl and $CaCl_2$ at a constant total concentration of 0·1 N have been measured at 25°. The conductances of the same mixtures have also been determined and from a combination of these data with the transference numbers the mobility of the H-ion constituent in each of the mixtures has been computed. The observed decrease in the mobility of this constituent in passing from the solution of pure HCl to one of pure $CaCl_2$ has been compared with the value computed from the interionic attraction theory of electrolytic conductance and also with a similar effect that was observed in mixtures of HCl and KCl. AUTHOR.

4688. Normal Potential of Ag-AgI Electrode. B. B. Owen. *Am. Chem. Soc., J.* 57. *pp.* 1526–1528, *Sept.*, 1935.—A method is described by which the normal potentials of certain electrodes may be compared in borax solutions without recourse to extrapolation. The normal potential of the Ag-AgI electrode has been determined from 5 to 40°. Results obtained with electrolytic and with fused AgI are practically indistinguishable. The dissociation constant of boric acid has been calculated from new measurements at $\mu = 0{\cdot}01$ molal. The results agree with previously reported values obtained by extrapolation. AUTHOR.

4689. Potential of Ag-AgCl Electrode in Methyl Alcohol-Water Mixtures. H. S. Harned and H. C. Thomas. *Am. Chem. Soc., J.* 57. *pp.* 1666–1668, *Sept.*, 1935.—E.m.f. measurements of the cells H_2 | $HCl(m)$ in X % CH_3OH–H_2O | AgCl | Ag from 0 to 40° at 5° temperature intervals have been made in methanol-water mixtures containing 10 and 20 % by weight of methanol. Vapour pressures and densities of methanol-water mixtures of these percentages from 0 to 40° are recorded. From these the molal electrode potentials of the Ag-AgCl electrode have been computed. AUTHORS.

***4690. Ag-AgBr Electrode for Measurements in Very Dilute Solutions. A. S. Keston.** *Am. Chem. Soc., J.* 57. *pp.* 1671–1673, *Sept.*, 1935.—A type of Ag-AgBr electrode prepared in a novel manner is described. Measurements of the cell H_2 (1 atm.) | $HBr(m)$ | AgBr | Ag were made at concentrations from 0·0001 to 0·02 *M* in quartz and pyrex glass cells of very simple design. Agreement with the limiting law of Debye and Hückel was obtained. The value of the molal electrode potential was found to be 0·0711 V. AUTHOR.

4691. Passivity of Gold. W. J. Müller and E. Löw. *Faraday Soc., Trans.* 31. *pp.* 1291–1299, *Sept.*, 1935.—Gold was shown to become passive in 5 *N* HCl as an electrolyte. The passivation was found to take place in accordance with the laws of passivation by surface layers, formulated by the authors. Gold exposed to air became coated with an oxide layer which was removed during passivation and the oxide-free surface became reoxidised when exposed to air. In dilute acid the oxide layer was not destroyed by anodic current. The relation between initial current and time of passivation in this case was : $(i - i_a)\, t =$ const. All the results failed to reveal any anomalies in the anodic behaviour of gold from the point of view of the theory of passivation by surface layers. F. J. B.

4692. Thallous-Thallic Oxidation-Reduction Potential. J. R. Partington and H. I. Stonehill. *Faraday Soc., Trans.* 31. *pp.* 1357–1371, *Sept.*, 1935.—A series of determinations were made of the oxidation-reduction potential of Pt electrodes in solutions of thallous and thallic sulphate at different concentrations of H_2SO_4. The comparison electrode was a Hg | $HgSO_4$, H_2SO_4 combination. The original paper must be consulted for the discussion of the results and their relationship to those obtained by other workers. F. J. B.

4693. Measurement of Polarisation-Potential. B. Gross. *Phys. Zeits.* 36. *pp.* 648–650, *Oct.* 1, 1935.—In the measurement of the polarisation-potential of an electrolytic cell, the voltage-measuring device must be connected to the cell immediately after switching off the polarising current. This operation is performed automatically at regular intervals by the arrangement described. A.c. passed through a half-wave rectifier supplies pulses of polarising current. The voltmeter or potentiometer is connected to the cell by means of a thermionic valve, the grid of which becomes charged to a large negative potential by the passage of the polarising current, so that the connection is virtually broken so long as this current persists. L. H.

See also Abstracts 4449, 4644, 4668, 4677.

ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

4694. Theory of Elementary Particles. Part II. Electromagnetic Whirls and Elementary Particles. N. S. Japolsky. *Phil. Mag.* 20. *pp.* 641–706, *Oct.*, 1935.—It is suggested that the elementary particles like electrons, protons, positrons, light quanta, and so on, can be considered as certain systems of Maxwell electromagnetic waves called " whirls." In this way the quantum and relativity relationships, including de Broglie's formula and gravitation, can be explained on the basis of classical electrodynamics. The interaction between the particles of such a nature follows, on the average, the inverse square law, which, however, breaks down when the distances between their centres are small, and, moreover, it admits occasional exceptions with a certain small probability. Being the forms of the Maxwell waves these particles do not imply any discontinuity of electric lines of force—in other words, they do not contain any " charge " in the usually accepted sense. It follows from this theory that the balance of the attractive and repulsive electrostatic forces between the particles requires a definite numerical ratio between the masses of the proton and the electron. This happens to agree with the experimental data. [For Part I see Abstract 4379 (1935).] AUTHOR.

4695. Ratio of Magnetic Moments of Proton and Deuton. A. Farkas and L. Farkas. *Roy. Soc., Proc.* 152*A*. *pp.* 152–157, *Oct.* 15, 1935.—The rate of reconversion of ortho-D_2 to normal D_2 in the presence of O_2 has been measured over the temperature range 83°–293° K. The velocity constants obtained have been compared with the corresponding velocity constants of the para-H_2 conversion, and from the ratio of the velocity constants, on the basis of the theory developed by Kalckar and Teller [see Abstract 3107 (1935)], the ratio of the magnetic moments of the proton and deuton have been determined as $3 \cdot 96 \pm 0 \cdot 11$. AUTHORS.

4696. Angular Distribution of Protons Projected by Neutrons. N. A. Dobrotin. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 2. *pp.* 516–519, *June*, 1935. *In English.*—Continuing previous work [see Abstract 2180 (1934)], a total of 145 protons projected by neutrons from paraffin wax was observed visually with an expansion chamber. Comparison of a few visual observations and actual photographs shows the visual method to be reliable. The angular distribution of projected protons is found to obey a $\cos^5\theta$ law, where θ is the angle between the initial direction of the neutron and the projected proton. It is shown that under the conditions of the experiment the result corresponds to an isotropic distribution. F. C. C.

4697. Collision of Swift Heavy Particles with Electrons. W. Braunbek. *Zeits. f. Physik*, 96. 9–10. *pp.* 600–606, *Sept.* 12, 1935.—Owing to the possibility that the primary penetrating radiation may consist of swift heavy particles, calculation is made of the number and energy of the secondary electrons which would be produced when such particles interacted with matter. The maximum energy transmitted to a free electron at rest is no longer $4m_0/M$ of the energy of the primary particle as on classical theory, the ratio now approaching the value unity at very high energies. For incident protons of energies above 10^9 eV, expressions are obtained for the number of secondary electrons to be expected in a given energy interval and for their angular distribution. F. C. C.

4698. Stopping Power of Atomic Nuclei for Kathode Rays. A. Sommerfeld and A. W. Maue. *Ann. d. Physik*, 23. 7. *pp.* 589–596, *Sept.*, 1935.—Previous work [see Abstract 575 (1932)] is extended, and it is demonstrated that certain simple formulæ give desired results without the complicated treatment required by considerations of relativity and retardation of the potentials. F. C. C.

4699. Reflection of Kathode Rays from a Crystal Surface. S. Miyake. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers. No.* 892. *pp.* 286–294, *Sept.*, 1935. *In English.*—Applying the exact solution of the wave equation for electrons to a simple potential model of a crystal, the position of the reflection spectrum and its breadth are determined. The results, which are based on elementary kinematical theory, are in good agreement with experiments on crystals of zincblende. F. C. C.

4700. Diffraction of Slow Electrons by Sublimed Tungsten. W. I. Kassatotschkin. *Acta Physicochimica*, 2. 3. *pp.* 317–336, 1935. *In German.*—Scattering of slow electrons of energies 40 to 400 kV by a sheet of microcrystalline sublimed tungsten is examined for a fixed angle of scattering. The inner potential of tungsten obtained from the displacement of the maxima is $\phi = 10\cdot5 \pm 0\cdot2$ V, and is independent of the electron velocity. The maxima may be divided into two groups connected with processes in which $\phi = 10\cdot5$ or zero respectively. The former group results from electron interference inside the crystal and the latter from interference produced at the step-like surface. The results are in good agreement with those of previous workers if it is assumed that diffraction takes place not from a single crystal surface, but from a sheet of non-orientated microcrystalline single crystals. F. C. C.

***4701. Diffraction of Slow Electrons. R. Suhrmann and H. Haiduk.** *Zeits. f. Physik*, 96. 11–12. *pp.* 726–740, *Sept.* 18, 1935.—An apparatus is described for measuring the intensity of the electron stream reflected from the surface of a crystal; from the position and shape of the diffraction maxima certain conclusions may be drawn concerning alterations in the crystal surface after treatment, *e.g.*, after electron bombardment. In order not to disturb the surface by the electrons in the incident beam, an arrangement is adopted to amplify the incident beam and record its intensity (of the order of 10^{-7} A) within 10 sec. The diffraction maxima are recorded before and after bombardment of the surface with slow electrons (10^{-5} A and 100 V) for 5 min. An electrometer is used to record the results photographically. The electron bombardment of galena and

pyrites causes the well-marked diffraction maxima to disappear for an hour or so, but they gradually return. Thermal treatment over the range 93° to 473° A has little effect on the maxima. [See following Abstract.]
H. J. H. S.

4702. Inner Potential of Galena, Pyrites, Bi and Stibnite. R. Suhrmann and H. Haiduk. *Zeits. f. Physik,* 96. 11–12. *pp.* 741–753, *Sept.* 18, 1935.—Using the method described [see preceding Abstract] to determine the position of the diffraction maxima, it is possible to calculate the inner potential E from the expression $E = 150/4.n^2/d^2 - V \cos^2 I$, where I is the angle of incidence of the beam, V is the potential at the diffraction maxima, *d* the distance apart of the diffracting planes and *n* the order of diffraction. *d* may be derived from X-ray data and this, with a knowledge of the positions of the different diffraction maxima gives E. Calculations are performed for galena (PbS) (E = 2·88 V) and pyrites (FeS_2) (E = 7·61 V). A graphical method is developed to determine E with more precision by the use of one diffracting plane (instead of many planes); this method gives negative values for E, *viz.*, − 3·63 V for PbS, − 3·54 for FeS_2, − 1·72 for Bi, and − 1·25 for stibnite. Using the values of E so determined, it is possible to calculate the potential values of the various diffraction maxima; good agreement is observed between the calculated and experimental values.
H. J. H. S.

4703. Intensity of Diffraction of Electrons by ZnO. H. J. Yearian. *Phys. Rev.* 48. *pp.* 631–639, *Oct.* 1, 1935.—Electron diffraction patterns of ZnO powder have been obtained in the range from 10 to 80 kV by using two types of camera. The intensity distribution shows marked deviations from that of the corresponding X-ray pattern. It has been shown that these deviations are not due to impurities, difference in structure due to methods of preparation, coincidences with another form of ZnO, or due to preferred orientation. Complete agreement between experimental and calculated curves for the scattering factor is obtained by assuming a distortion of the electron cloud (M shell of the zinc and L shell of oxygen) resulting in a different parameter for the distance Zn nucleus—oxygen nucleus, and Zn electrons-oxygen electrons. The resulting structure factor has the form $S = Z(\mathrm{Zn}) - \Sigma F_{n,l}(\mathrm{Zn})e^{2\pi i a_{n,e} l} + Z(\mathrm{o})e^{2\,iql} - F_{n,l}(\mathrm{o})e^{2\pi i(a+b_{n,e})l}$.
AUTHOR.

4704. Diffraction of Electrons by Metal Crystals and by Mica. J. A. Darbyshire and E. R. Cooper. *Roy. Soc., Proc.* 152*A*. *pp.* 104–123, *Oct.* 15, 1935.—The object of the research was to examine the spot patterns obtained when an electron beam of 30 kV velocity is transmitted through a crystalline film. The paper is divided into two sections. The first section is a brief review of the work relating to such patterns; the reciprocal lattice picture of electron diffraction is presented in a form suitable for discussing the results. In the second section a number of patterns representative of those obtained from Cd, Zn, and Bi are described. The crystals of these metals were obtained by withdrawing the surface oxide film from the molten metals in air and in nitrogen; these films produced Debye-Scherrer patterns due to the oxide and also spot patterns due to occluded metal crystals. The spot patterns were found to be due chiefly to distortion of the metal crystals. Forbidden spectra were observed. The results obtained by transmitting an electron beam through curved sheets of mica are also described, and these again support the conclusion that the spot patterns are due chiefly to distortion of the diffracting crystal.
AUTHORS.

4705. Discharge and Ionisation Diameter of He and He$^+$. F. Wolf. *Ann. d. Physik*, 23. 7. *pp.* 627–647, *Sept.*, 1935.—An earlier work [see Abstract 3764 (1935)] is extended to the measurement of the discharge diameter of gases in comparison with that of slow positive ions. The method employed has the advantage that disturbances usually encountered in this work are eliminated or diminished. The discharge diameter of He compared with He$^+$ ions decreases linearly with increasing voltage in the region 20–1020 V, and is of the same order as the previously determined effective diameter. This is in accord with theory. Ionisation of He by He$^+$ ions appears to set in at just under 400 V. The shape of the discharge and ionisation curves are discussed. Measurements on the discharge diameter of He compared with slow H$_2^+$ ions gives a much smaller value than that for He$^+$ ions. H. J. H. S.

***4706. Electron-Optical Researches on High-Vacuum Braun Tubes. E. Brüche.** *Arch. f. Elektrot.* 29. *pp.* 642–654, *Sept.* 10, 1935.—Measurements are described on a number of electron-optical immersion systems which are suitable for high-vacuum kathode-ray oscillographs. The magnification given by a diaphragm system is determined for different positions of the diaphragms and is compared with the values in the literature. The magnification and potential relations existing in 9 systems consisting of 2 cylindrical electrodes are measured in terms of the dimensions of the system. The ability of a system to form a spot or an image is compared, followed by a discussion of the general properties of the systems described. H. J. H. S.

4707. Electron Concentration by Concave Hot Kathode Surfaces with the Electron Microscope. G. Kemmnitz, M. Knoll and W. Walcher. *Zeits. f. Physik*, 96. 9–10. *pp.* 612–619, *Sept.* 12, 1935.—Magnified electron-optical images of small depressions (grooves of semicircular and triangular section and cup-shaped holes) made in Ba vapour hot kathodes show clearly the effect of electron concentration in these depressions. Suggestions are made to account for this concentration. The focal distance of the elementary pencils depends on the radius of curvature of the depression and on the electron density and this is demonstrated experimentally. H. J. H. S.

***4708. Magnetic Electron Lens without Image Rotation. G. Stabenow.** *Zeits. f. Physik*, 96. 9–10. *pp.* 634–642, *Sept.* 12, 1935.—A method is sought to overcome the image rotation which is produced by a magnetic lens. Since the power of such a lens is proportional to the square of the field strength, and the angular rotation is directly proportional to the field strength, it seems possible, by the choice of a suitable field, to obtain a given power and rotation (*e.g.*, rotation = 0°). For this purpose, 2 magnetic lenses are constructed and it is arranged that the exciting current flows in opposite directions in each coil. It is demonstrated that an image may be obtained with zero rotation. Suggestions are made for the construction of a magnetic lens doublet with zero image rotation. H. J. H. S.

***4709. Use of Electron Lenses for β-Rays. O. Klemperer.** *Phil. Mag.* 20. *pp.* 545–561, *Oct.*, 1935.—The magnetic field distributions of various electron lenses have been measured and their optical qualities are discussed. Two different types of β-ray spectrographs have been constructed: one in order to obtain high intensity and the other to obtain high resolving power. Practical experience gained with these spectrographs is described. AUTHOR.

***4710. Electron Distribution at Focus of X-Ray Tubes with Electron Microscope. J. Dosse and M. Knoll.** *Arch. f. Elektrot.* 29. *pp.* 729–730, *Oct.* 5, 1935.—A method is described for measuring quantitatively the electron density at the anti-kathode of an X-ray tube. A number of small radial holes are drilled in the anti-kathode and a magnetic electron microscope is arranged to form an enlarged image of the holes on a screen. A central hole drilled in the screen enables the electrons to pass through into a Faraday cage which serves to record the electron density. The pencil of rays from each hole in the antikathode are brought in turn to the central hole in the screen by means of a magnet and the electron density recorded. In this way the electron distribution on the antikathode of a diagnostic X-ray tube is explored for various exciting potentials. The aim of the work is to provide an electron-optical basis for the construction of X-ray tubes. H. J. H. S.

See also Abstracts 4451, 4481, 4615.

ELECTROSTATICS.

***4711. Electrostatic Machine. H. Strauch.** *Phys. Zeits.* 36. *pp.* 575–584, *Sept.* 1, 1935.—The theory of the electrostatic influence machine is outlined, and the characteristic curves of the self- and separately-excited machines are developed. E. R.

See also Abstracts 4662, 4741.

MAGNETISM AND ELECTROMAGNETISM.

4712. Magnetic Moment of the Manganic Ion. L. C. Jackson. *Phys. Soc., Proc.* 47. *pp.* 1029–1031, *Nov.* 1, 1935.—The magnetic susceptibility of manganic acetylacetone has been measured for a powdered specimen from 292° to 16·9° K. The law $\chi\ (T + 5\cdot 5) =$ a constant is obeyed down to about 75° K., below which the susceptibility increases somewhat more rapidly than is indicated by this law. The magneton number for the Mn^{+++} ion, for which no reliable data were previously available, is 4·98 as calculated from the above relation. This is in good agreement with the requirements of the Bose-Stoner theory. AUTHOR.

4713. Magnetic Susceptibility of Mixed Oxides of the Rare Earths. L. Mazza. *Accad. Lincei, Atti,* 21. *pp.* 813–818, *June* 16, 1935.—The applicability of Urbain's method of magneto-chemical analysis depends on the strict additivity of the magnetic susceptibility in mixtures, With mixed rare earths this is, however, not the case when one of the two constituent elements is able to given a quadrivalent ion. With mixed oxides of Nd and Sm, the susceptibilities lie on a straight line. With mixtures of the oxides of Pr and Nd, however, the susceptibility is higher than the calculated value when 0–25 % of $Pr_6\,O_{11}$ is present and lower than the calculated value for mixtures with 25–100 % of $Pr_6\,O_{11}$. T. H. P.

4714. Influence of the Formation of Hydrates on the Diamagnetism of Chemical Compounds. P. S. Varadachari. *Indian Acad. Sci., Proc.* 2*A*. *pp.* 161–175, *Aug.*, 1935.—Sulphuric acid-water and acetic acid-water mixtures have been investigated. Above 86 % sulphuric acid the values of the susceptibility are greater than those given by the additive law, whilst below 86 % the values are lower. The greatest deviations correspond with the formation of the following hydrates : $2H_2SO_4$, H_2O ; H_2SO_4, H_2O ; H_2SO_4, $3H_2O$; H_2SO_4, $6H_2O$; and H_2SO_4, $18H_2O$. Divergences from the results of Farquharson are discussed and evidence for the existence of these hydrates by other physical measurements is reviewed. Acetic acid—water mixtures obey the additive law. It has been found that the susceptibility of sodium sulphate decahydrate is exactly the same above and below the transition point and in solution also. This suggests that the water molecules are more loosely bound than in the sulphuric acid hydrates. [See Abstract 5247 (1934).] W. R. A.

4715. Magnetic Anisotropy of Crystals of Sn, and of Sn with Added Sb, Cd, or Ga. H. J. Hoge. *Phys. Rev.* 48. *pp.* 615–619, *Oct.* 1, 1935.—The principal magnetic susceptibilities of single crystals of white (tetragonal) tin have been determined. Crystals were grown by the travelling furnace method. Perpendicular to the tetragonal axis the susceptibility (per unit volume) is $\kappa_{\perp} = 0 \cdot 197 \times 10^{-6}$; parallel to the axis it is $\kappa_{\parallel} = 0 \cdot 176 \times 10^{-6}$. The ratio $\kappa_{\perp}/\kappa_{\parallel}$ is strongly influenced by the addition of small amounts of certain elements. For tin containing no added element this ratio is 1·120. Adding 0·60 % Sb the ratio is 1·200; 0·76 % Cd, 0·923; 0·89 % Ga, 0·897. The relation between the change in this ratio and the number of valence electrons of the added element is compared with available data for bismuth. AUTHOR.

4716. Viscosity Bands in Magnetic Spectra. O. Veletzkaia. *Zeits. f. Physik*, 96. 3–4. *pp.* 173–176, *Aug.* 22, 1935.—In the range of about 1-cm. waves Arkadiew found absorption spectra in the magnetic spectrum of iron and nickel wires. He has shown that there is a sharp declination in the values of the permeability for 1-cm. and 10-cm. waves. These are exemplified in curves. The present work undertakes the establishment of the formulæ of Arkadiew for the spectrum bands of the elastic permeability and gives an excellent concurrence between the experimental and the theoretical curves. A new series of constants for the magnetic viscosity are derived and the values set out in tabular form. S. G. B.

4717. Effect of Magnetisation on Young's Modulus of Ferromagnetic Substances. K. Nakamura. *Tôhoku Univ., Sci. Reports*, 24. *pp.* 303–331, *Aug.*, 1935. *In English.*—Three methods for measuring Young's modulus and its variation by magnetisation in ferromagnetic substances are described. One of them is similar to that used by E. Giebe and E. Blechschmidt [see Abstract 1741 (1932)], and the second is an ordinary triode valve magnetostriction oscillator slightly improved for the purpose. The third method is due to the author. Using these methods Young's modulus and its variation by magnetisation for Fe, Ni, Co and Ni-Fe alloys were measured. Young's modulus of Fe and Co was almost independent of their magnetisation. In the case of Ni, the result of Giebe and Blechschmidt, that the variation is proportional to magnetisation, is confirmed. For Ni-Fe alloys which contains less than 30 % of Ni, the effect is very small. It has a maximum for about 50 % of Ni; generally it is smaller than that for pure Ni. AUTHOR.

4718. Validity of the Becker Equation for the Initial Permeability of Strongly Drawn Nickel Wire. Gertrud Scharff. *Zeits. f. Physik*, 97. 1–2. *pp.* 73–82, *Sept.* 23, 1935.—The initial susceptibility of stretched nickel wire was investigated as a function of the temperature. The results indicate that the use of the Becker equation for the initial magnetisation of a strongly stretched nickel wire: $n_0 = J_0/H = J_\infty^2/3\lambda_K Z$ is valid for higher temperatures. Near the Curie point and in the range of temperature leading thereto the linear nature of the magnetisation curve is established. The magnetisation with a constant field is diminished by the application of higher external stretching force. Thereby a state is reached where stretching force multiplied by initial susceptibility gives a constant. The quantity $J_{\infty}^{2}/3\,\lambda_{K}Z$ obtained from magnetic measurements at all temperatures is found to accord with the measured magnetostriction (λ_K) at saturation value, and also to agree with the Matteucci effect value obtained by Englert. S. G. B.

4719. Negative Matteucci Effect. E. Englert. *Zeits. f. Physik*, 97. 1–2. *pp.* 83–93, *Sept.* 23, 1935.—The Becker theory for magnetisation is developed for nickel wires subjected to torsional stress, and the temperature relationships of the negative Matteucci effect and the magnetisation of a twisted nickel wire are measured. The Becker theory is used for the evaluation of the negative Matteucci effect for a nickel wire and tube, the results being in good agreement both in theory and practice. Full experimental and theoretical discussions are appended. S. G. B.

4720. Displacement of the Curie Point by Tension. E. Englert. *Zeits. f. Physik*, 97. 1–2. *pp.* 94–96, *Sept.* 23, 1935.—No influence due to tension or striction on the Curie point is found, and if it does exist, it is certainly more than twenty times smaller than the value suggested by Ray and Chaudhuri. S. G. B.

***4721. Mercury Helix Permeameter. G. Somaini.** *Elettrotecnica*, 22. *pp.* 588–591, *Sept.* 6, 1935.—A plane helix of mercury is made by filling the helicoidal space left by a flat spiral of wire sandwiched between two blocks of insulating material. Current traverses the system radially, crossing mercury and wire alternately, two concentric copper rings serving as electrodes. When such a system is placed at right angles to a magnetic field, it follows from Ampère's law that an axial pressure is developed in the mercury spiral and that this pressure is a measure of the flux through the spiral. In the permeameter described such a system is enclosed between two Permalloy rings which complete the magnetic circuit of a solenoid in which is placed the test specimen. With the specimen " out," a reading is obtained on a manometer communicating with the mercury spiral; with the specimen " in " the reading is reproduced by altering the solenoid current. From the two values of current and the dimensions of the solenoid and specimen, B and H can be calculated; the actual manometer reading appears only in a small correcting term. N. F. A.

***4722. Flux Measurement in Iron-Cored Coils: Direct-Reading Inductance-Meter. M. Robert and J. Foglia.** *Comptes Rendus*, 201. *pp.* 520–522, *Sept.* 23, 1935.—The inductance of an iron-cored coil is determined as the ratio of maximum flux $\varnothing_{max}$ to maximum current I_{max}. A peak ammeter [see Abstract 3964 (1931)] reads I_{max}, and $\varnothing_{max}$ is deduced from the mean inductive voltage V_m and the frequency. V_m is read by means of some form of rectifier voltmeter, which is connected in series with the secondary of a step-up transformer, so arranged that its secondary p. d. is equal and opposite to that due to the resistance of the circuit under test. The reading of V_m then depends on the inductance only. The apparatus may be made to read inductance directly by the use of two pointer instruments for V_m and I_{max}, with crossed pointers. L. H.

***4723. Multi-Lamellar Cylindrical Magnetic Shields. T. E. Sterne.** *Rev. Sci. Instruments*, 6. *pp.* 324–326, *Oct.*, 1935.—A method is described by which the shielding ratio of a system of coaxial cylinders may be rapidly computed by means of recurrence formulae. For cylinders of infinite length the method is exact and general, being applicable to the case of *n* coaxial cylinders, of any radial dimensions, in contact or separated by gaps, and composed of the same or of different material. The method should give reasonably correct results when applied to systems of cylinders of finite length but with closed ends. It is illustrated by numerical applications to shields with more than 19 components. AUTHOR.

***4724. Laboratory Relay. H. P. Bloxam.** *Journ. Sci. Instruments*, 12. *pp*. 313–316, *Oct.*, 1935.—A method of mounting mercury tubes as relays is given, combining substantial and simple construction, reliability, and freedom from sparking at the controlling contacts. AUTHOR.

See also Abstracts 4460, 4624, 4694.

MEDICAL RADIOLOGY AND ELECTROLOGY.

4725. Ionic Theory of the Physiological Action of Short Waves. P. Lazarev. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 3. 1. *pp*. 31–34, 1935. *In French.*—As it has been shown that the action of short waves does not depend on the heating effect, an attempt is made to explain their action in terms of the transport of ions under the action of the field and changes of state of colloids in the cells. Calculations on the movement of colloidal particles shows that the sensitivity of cells for continuous current is greater in the presence of short waves, a result stated to be in accordance with experimental observations. The theory also suggests the absence of selective action. G. E. B.

***4726. Short-Wave Measurement in Electrotherapy. F. Pasteur.** *J. de Radiologie et d'Électrologie*, 19. *pp*. 436–440, *Aug.*, 1935. —In medical work, to allow repetition of treatment, precise physical measurement, consistent with medical requirements, is necessary. One apparatus to define the treatment is the wavemeter. A further instrument is a quantimeter and such an instrument designed by the author employing a thermo-ammeter is described but not illustrated. The measurements entailed are described and the energy consumption considered for different regions of the body, when submitted to h.f. radiation. Finally, certain purely medical conceptions are discussed. B. J. L.

4727. Temperature-Rise of Small Bodies in H. F. Fields. W. Krasny-Ergen. *Hochfrequenztechn. u. Elektroakustik*, 46. *pp*. 85–90, *Sept.*, 1935.—Calculation is made of the temperature distribution in a system of small bodies subjected to the heating effect of a h.f. field. In the case of systems which are geometrically similar and have proportional physical constants at corresponding points, also in which the potentials due to the applied fields are proportional, it is shown that the temperature distributions have a simple relation. Hence it is possible from temperature measurements on a system of relatively large particles to deduce the temperature distribution for a system of small bodies such as a colony of bacteria. A. W.

4728. Oscillating Currents in Complex Circuits. P. Bauwens. *Brit. J. of Radiology*, 8. *pp*. 615–624, *Oct.*, 1935.—The author contends that tissues introduced in ultra h.f. fields should be regarded electrically as a complex system of condensers shunted by resistances in series with more resistances. It is held that, in addition to the heat generated by virtue of the Joule effect, and dielectric hysteresis, vibrations are set up in the tissues at a frequency double that of the field. These vibrations are essentially the result of the cellular structure of tissues and act as a mild irritant producing a mild inflammatory reaction. The author postulates that non-specific defensive processes are elicited and that some intermediate substances akin to Lewis's " H " substance may possibly be liberated. It follows that the bactericidal action of this therapeutic agent resolves itself into an indirect one due to the defensive processes initiated in the tissues. AUTHOR.

4729. Effect of Scattered Radiation on the Radiographic Image. G. Spiegler. *Zeits. f. wiss. Phot.* **34.** *pp.* 197–204, *Aug., and pp.* 205–215, *Sept.*, 1935.—By means of a phantom apparatus in which the object radiograph is formed by three lead plates in different positions, comparative radiographic images of various sharpness are obtained, illustrations being given. These results are generally discussed in respect to the effect of scattered X-rays upon the image formation and the comparative importance of the direct and scattered components. Appertaining literature is referred to. The discussion is particularly in respect to the object-film distance. Nearness of the object to the film decreases the unsharpness, and there is a rapid increase of this when the object is more than 1 cm. from the film, with resulting loss of contrast, the variation of contrast with the object-film distance being expressed by graphs. Typical radiographs, due to scattered radiation only, are shown. The unsharpness of the image can be expressed in terms of the transitory changes of the edges of the image and the radiographic image is a mixture of the sharp and unsharp images. A scheme to define the blackening differences in respect to the radiograph is given. B. J. L.

4730. Relation of Air Ionisation to Radiation Absorbed and the Effect on the Body Tissues. W. H. Meyer. *Radiology*, 25. *pp.* 198–202; *Disc.*, 202–206, *Aug.*, 1935.—In spite of physical standards having been defined, there is considerable doubt and controversy as to the relation of physical dose and biological action. Various investigations in this respect are mentioned and the author, after referring to his earlier work, illustrates a table respecting ionisation measurements in co-relation to epilation. As a measurement of ray quality the half layer value is accepted. The value of measurements utilising Drosophila eggs is questioned, since human tissues, unlike these eggs, have a rich vascular and lymphatic supply, and variation in measurements of biological reaction is not considered to be due to the thickness of wall of the ionisation chamber. Mass absorption is considered as the fundamental cause of variations of biological reaction to radiation. B. J. L.

4731. Relation between Age and Radiosensitivity of Drosophila Eggs. C. Packard. *Radiology*, 25. *pp.* 223–230, *Aug.*, 1935.—The radiosensitivity of Drosophila eggs increases rapidly during the early stages of nuclear division, attaining a maximum when the embryo shows the first sign of differentiation. Thereafter, it falls abruptly, but rises a little during the period of gastrulation. It then declines slowly. The course of the survival curves for eggs of different sensitivities and stages of development remains constant. It is an expression of the variation in sensitiveness of the individual eggs composing the samples. AUTHOR.

4732. Rôle of X-Ray Wave-Length in Skin Tolerance. P. C. Hodges, A. Brunschwig and S. P. Perry. *Am. J. of Roentgenology and Radium Therapy*, **34.** *pp.* 234–240, *Aug.*, 1935.—Whilst, during the past decade, the majority of therapeutic X-ray treatment has not utilised apparatus employing more than 200/kV claims have been made for superior results which would be obtained by use of higher voltages. Unfortunately, to investigate the relating questions, expensive installations are necessary and, before incurring such expenditure, the logic of such claims must be considered. It is generally and logically agreed that the depth dose is increased by increase of voltage. Other claims relate to greater destruction of neoplastic tissue with shorter wave-length and that the skin and superficial tissues are less injured with shorter wave-lengths. Past investigations in this respect are discussed and then detailed results given of investigations upon 11 rabbits and 7 human subjects, irradiated at 200 kV and 80 kV. The skin intensity was found to be approximately 15 % greater at 80 kV than at 200 kV. Variations with respect to time were found with 3 human subjects, during the course of the skin reaction, although the earlier and final reactions were the same. It is considered that, over the voltage range of 80–200 kV, the skin reaction is independent of wave-length and there is no reason to believe any specific effect of wave-length occurs for voltages exceeding 200 kV. B. J. L.

4733. X-Ray Protection. Part VI. E. I. L. Cilley, E. T. Leddy and B. R. Kirklin. *Am. J. of Roentgenology and Radium Therapy*, **34.** *pp.* **241–247,** *Aug.*, **1935.**—Continues extensive investigations [see Abstract 3677 (1935)]. In the present paper further data are given regarding the doses received by the radiologist in carrying out examinations by means of the vertical screening stand and the X-ray couch. In practice, the examiners, in routine gastric and colonic examinations, wear no protective devices as aprons, etc., but the doses which can be tolerated are multiples of the usually agreed " tolerance dose." Although such is the case, it is not recommended that the usual precautions should be neglected. For protection the necessity is stressed of speed of examination, protection during examination of the barium filled viscus and the use of as small a beam of irradiation as possible. Differences between photographic and ionisation measurements during the investigations are discussed and some reasons for the differences given. B. J. L.

4734. Depth Doses of X-Rays. L. H. Clark and (Miss) E. W. Chapman. *Brit. J. of Radiology*, 8. *pp.* 625–636, *Oct.*, 1935.—Depth doses in wax due to X-rays excited by 200 kV with 1 mm. Cu filter, are obtained for a focal skin distance of 60 cm., with a number of apertures. The results are found approximately to fit the formula $I_D = I_p(1 + a_1D)$, when there is no scattering medium below the ionisation chamber, and $I_D = I_p(1 + aD + b)$, when a back scattering layer is present. Here I_p is the intensity of the primary radiation present at depth D, and a, a_1, b are constants depending on the aperture. A theoretical basis for the formulæ is given. An experimental analysis of the scattered radiation shows the presence of singly and doubly scattered rays. J. E. R.

4735. Intensity and Dosage Near Radium Needles. G. C. Laurence. *Radiology*, 25. *pp.* 166–181, *Aug.*, 1935.—The distribution of intensity in the neighbourhood of radium needles is discussed, in an attempt to simplify the calculation of dosage, to a degree of relative accuracy consistent with practical clinical requirements. Two units of quantity of irradiation have been used, namely the *r* unit and the mg. hr./cm.^{2}. Isodosis charts prepared in recognised institutes, are not generally applicable since radium needles differ in design and arrangement. In the present paper formulæ and graphs are derived, which permit the dosage to be determined for any particular condition. The dosage at any point near a radium needle, of shown dimensions, is discussed and the preparation of isodosis charts is explained in detail. After discussing the measurement of γ-rays in terms of röntgens and the ratio of *r* to mg. hr./cm.^{2} units, which is given as a mean value of 8·6, theoretical formulæ and tables are derived. B. J. L.

4736. Bactericidal Effects of X-Rays. F. L. Mohler and L. S. Taylor. *Am. J. of Roentgenology and Radium Therapy*, 34. *pp.* 89–91, *July*, 1935.—The effect of X-rays in liquids is considered as due to ionisation of a columnar tract by the high-speed electron. This concept is discussed in relationship to the biological action, particularly in respect to cultures of colon bacilli. From the theoretical area of ionisation, in relation to the size of a bacillus, it is considered that passage via the bacillus is generally not fatal, and the column must pass through a particular point of the bacillus to cause death, but the actual biological result is apparently entirely due to ionisation, although the effect can vary with the particular biological material affected. B. J. L.

OSCILLATIONS.

See Abstracts 4677, 4728.

PHOTOELECTRICITY.

4737. Influence of the Medium on the Photoelectric Effect of Metals in a Dielectric. L. W. Groschew. *Phys. Zeits. d. Sowjetunion*, 7. 5–6. *pp.* 619–630, 1935. *In German.*—The inner photoelectric effect in red rock-salt, coloured with colloidal copper is considered as an external effect on the metal in a dielectric. In the region of full absorption, the photoelectric stream relative to unit absorbed energy increases uniformly with decreasing wave-length. A weak maximum in the photoelectric current wave-length curve at 590–600 $\mu\mu$ corresponds to a feature of the absorption curve. The threshold lies at about 640 $\mu\mu$ in contrast to the vacuum threshold of 260 $\mu\mu$. J. E.

4738. Photoelectric Spectral Selectivity. W. Kluge. *Zeits. f. Physik*, 96. 9–10. *pp.* 691–697, *Sept.* 12, 1935.—Kathodes of Ag–Cs$_2$O–Cs, Cu–Cs$_2$O–Cs, and Cs in bulk were treated with oxygen in several steps. The emission and the threshold wave-lengths decreased successively. In the case of the first two kathodes the successive diminution of the short-wave maxima was not nearly so rapid as that of the long-wave maximum, which usually disappeared at the first stage of treatment. The long-wave maximum was not exhibited by Cs in bulk. The positions of the short-wave maxima were unaffected. The results are discussed, and it is concluded that the centres of the long-wave emission are the adsorbed Cs particles. D. H. F.

See also Abstracts 4424, 4574, 4660, 4741.

PIEZOELECTRICITY.

4739. Displacements in Piezoelectric Media. A. D. Hestenes and H. Osterberg. *Physics*, 6. *pp.* 291–293, *Sept.*, 1935.—A general solution is presented for the displacements induced in any piezoelectric medium by static electric fields which are constant throughout the medium. This solution is then specialised to the case of α-quartz. The solutions for α-quartz have been used by the second writer in an accurate remeasurement of its piezoelectric moduli. The piezoelectric behaviour of α-quartz is found to be closely predicted by these solutions. AUTHORS.

4740. Piezoelectric and Elastic Properties of β-Quartz. H. Osterberg and J. W. Cookson. *Frank. Inst., J.* 220. *pp.* 361–371, *Sept.*, 1935.—High or β-quartz possesses piezoelectric properties which are characteristic of hexagonal holoaxial crystals. Crystal plates provided with electrodes were placed in a furnace; the electrodes were connected to a h.f. oscillator, and the motion of any surface of the crystal at resonance was studied by observing the interference fringes formed between this surface and a flat piece of fused quartz. The crystals oscillated violently in the *yz* and *zx* shear modes at temperatures ranging from 575°–847° C., and β-quartz proved in many ways a superior piezoelectric material to α-quartz. The absence of longitudinal modes in β-quartz, as also the striking difference in the behaviour of α- and β-quartz as regards the *yz* and *zx* shear modes, confirmed the theory. P. V.

See also Abstract 4675.

THERMIONICS.

4741. Surface Electrons. Part I. H. Rukop, W. Schottky and R. Suhrmann. *Die Physik*, 3. 3. *pp.* 133–178, 1935.—Recent work on photoelectric and thermionic emission, contact potentials and surface fields is reviewed in three separate sections. D. H. F.

4742. Effect of Secondary Emission upon the Fluctuations of the Current in a Triode (Shot Effect). W. H. Aldous and N. R. Campbell. *Roy. Soc., Proc.* 151*A. pp.* 694–702, *Oct.* 1, 1935.—In a recent paper [see Abstract 5269 (1934)] Moullin has measured the shot voltage under conditions such that the secondary electrons produced at the anode might leave the anode permanently for a neighbouring grid. He interpreted his results on the assumption that the primary and secondary emissions were wholly independent in time. It is here argued that it is more plausible to assume that secondary emission and primary incidence are simultaneous. With this assumption a theory of the effects of secondary emission is based on a proposition previously advanced by Campbell and proved by Rowland, in a paper about to be published. It is concluded that a quantitative estimate of the fluctuations requires a knowledge of the chances of the various alternative processes involved in secondary emission; such knowledge is not available, but certain qualitative predictions are confirmed by Moullin's experiments. Generally it is concluded that all known theories of fluctuations are inadequate when ρ (the impedance of the valve) is finite and that an adequate theory is far beyond our present reach. A. W.

4743. Measurement of Saturation Currents for Glowing Kathodes with High Emissivity. E. Patai and G. Frank. *Zeits. f. techn. Physik*, 16. 9. *pp.* 254–262, 1935.—The method of measurement is one in which a high emission of electrons can be reached without injury or destruction of the containing valve. The emission is of short duration; a charged condenser is discharged through the experimental valve, and the maximum values of the resulting impulsive currents are measured by a special valve-electrometer circuit which registers the impulses. The method is discussed with special reference to sources of error and a table and diagrams show the results for various types of commercial valves. An experiment is described, and results are shown, of the determination of Richardson's constant over a wide temperature range for various kathodes, including tungsten. H. M. B.

See also Abstract 4707.

THERMOELECTRICITY.

See Abstract 4628.